Electrical engineer

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Alphabetical Index of Contents.

A denotes Articles. ***A** denotes Illustrated Articles. **Ax** denotes Abstracts and Extracts. ***Ax** denotes Illustrated Abstracts and Extracts.
E denotes Editorials. **L** denotes Letters to the Editor. **L N** denotes Legal Notes. **N** denotes News and Notes.
R denotes Reviews of Books. **P N** denotes Patent Notes. **T N** denotes Trade Notes and Novelties and Mechanical Department.

PAGE.

A

B

C

AUTHORS.

INDEX.

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FORMULÆ FOR CALCULATING THE DIAMETER AND LENGTH OF AN ARMATURE.—ARRANGED FROM GISBERT KAPP'S "TRANSMISSION OF ENERGY."[1]

BY A STEAM ENGINEER.

THE general introduction of the electric motor into service, which has been performed heretofore by steam motors, compels the steam engineer to familiarize himself with the construction of the electric motor. It is natural enough for him to attack this, for him, in the beginning, odd problem, by applying methods used in his former engine practice. I am aware, that many electricians will smile, believing that principles cannot be made plain and successful or results reached except by the use of the C. G. S. unit system. The majority of ordinary mortals are for this reason deterred from desecrating the electrical field and I too would hesitate to state formulæ, which I have found useful in my exclusively practical work, if I did not feel encouraged by such authorities as G. Kapp and S. P. Thompson, who cheerfully call E. M. F., pressure and use valve diagrams to explain its variations.

In Gisbert Kapp's "Transmission of Energy" (First Edition, page 27) we find, that one absolute ampere turn or one coil traversed by a current of one absolute unit and of such size as to enclose and vary 6,000,000 lines of force, when standing in its best position, will swing from the position of minimum enclosed, or when standing with its plane parallel to the lines of force in the same way, as if it was turned by a steam engine with an infinite length of connecting rod, two centimetres stroke and 6,000,000 dynes effective total piston pressure. It follows a sine law and has four variations from best position to dead centre per revolution, or while passing from centre of north pole to centre of next north pole.

If we call n the number of revolutions per minute, C the number of coils, or in drum armatures the number of wires on the periphery, and i current in amperes, the work per second will be:

$$6{,}000{,}000 \times \frac{n}{60} \times 2 \times 2 \times \frac{Ci}{10} \text{ dyne-centimetres or ergs,}$$

which should be multiplied with p for a dynamo or motor having p pairs of poles. The work per second is also by agreement expressed by $2\,p\,E\,i$ volt amperes or $10^7 \times 2\,p\,E\,i$ dyne-centimetre or erg. Consequently $10^7 \times 2\,p\,E\,i = \frac{n}{60} \times \frac{4\,Ci}{10} \times p \times 6{,}000{,}000$; or 1), $E = \frac{2\ Cn}{1000}$ in motors with p sets of brushes; or 2), $E = \frac{2\ Cn}{1000}\,p$, for motors with one set of brushes; and 3), $E = \frac{2\,C\,n\,p\,k}{1000}$ for alternators.

B = number of lines per square inch of armature section; L = length of armature in inches; d = diameter of armature in inches; r the ratio of the armature diameter by the radial depth, so as to express the area by $\frac{Ld}{r}$, or by $\frac{L\,d^2}{dr}$. The number of lines passing through the armature section will be $\frac{B\,L\,d^2}{dr}$.

Arranging formulæ 1), 2), 3), we have for $\frac{B\,L\,d^2}{d\ r}$ lines, since the pressure increases directly as the number of lines or strength of field:

1a.) $$\frac{2\ B\ \frac{L}{d}\ \frac{d^2}{r}\ Cn}{6{,}000{,}000{,}000} = E;\ \text{or}\ C = \frac{3{,}000{,}000{,}000\ E}{\frac{B}{r}\ \frac{L}{d},\ n\,d^2}.$$

2a.) $$\frac{2\ \frac{B}{r}\ \frac{L}{d}\ d^2\ C\,n\,p}{6{,}000{,}000{,}000} = E,\ \text{or}\ C = \frac{3{,}000{,}000{,}000\ E}{\frac{B}{r}\ \frac{L}{d}\ n\,d^2\,p}.$$

3a.) $$\frac{2\ K\,p\ \frac{B}{r}\ \frac{L}{d}\ d^2\ C\,n}{6{,}000{,}000{,}000} = E,\ \text{or}\ C = \frac{3{,}000{,}000{,}000\ E}{\frac{B}{r}\ \frac{L}{d}\ n\,d^2\ Kp}.$$

600,000 dynes per ampere turn pushing on a crank of one centimetre are approximately equal to $\frac{\pi}{6}$ pounds acting on a one-inch crank.

The work done by an engine with $\frac{\frac{B}{r}\ \frac{L}{d}}{6{,}000{,}000}\,d^2\,\frac{\pi}{6}\ Ci$ total effective piston pressure, two-inch stroke, and n revolutions per minute is $= \frac{\frac{B}{r}\ \frac{L}{d}}{6{,}000{,}000} \times \frac{d^2\,\pi}{6} \times \frac{2\ n}{6}.\ Ci$ foot pounds

$$= \frac{\frac{B}{r}\ \frac{L}{d}}{9{,}000{,}000}\,Ci \times \frac{2\ n}{6} \times \frac{d^2\ \pi}{4} \text{ foot pounds.}$$

The first factor corresponds to pressure per square inch referred to area $\frac{d^2\,\pi}{4}$ and $\frac{2\ n}{6}$ is piston speed per minute for two-inch stroke. Each pair of poles is equal to one cylinder and we have as a general formula:

A.) $$\frac{p\,\frac{B}{10{,}000\,r} \times \frac{L}{d} \times \frac{Ci}{27} \times \frac{n}{100} \times d^2}{42{,}000} = \text{Electric motor h. p.}$$

To find C, the number of turns or coils, for a given pressure in volts E, we take D_m = pitch of coil in mils on periphery of armature. For a bare wire of diameter in mils d_m it will be 1.2 ($d_m + 16$). The coefficient 1.2 allows for insulation and driving pieces, l_n being the number of layers.

Then diameter of armature $= \frac{D_m\ C}{1000 \times 3.14 \times l_n}$; and $d^2 = \frac{D_m^2\ C^2}{1000^2 \times 10 \times l_n}$ or, $C^2 = \frac{1000^2\ l_n^2\ d^2}{D_m^2}$ 10, we have also

1. Copyrighted, 1893.

$$C = \frac{3,000,000,000\ E}{\frac{B}{r} \cdot \frac{L}{d} \cdot n\, d^2\, K p}\ ;\ \text{or} = \frac{3000\ E}{\frac{B}{10,000} \cdot \frac{L}{dr}\, \frac{n}{100}\, d^2\ Kp},$$

$$\text{and } C^3 = \frac{1000^2 \times 30,000\ l_n^2\ E}{D_m^2\ \frac{B}{10,000} \cdot \frac{L}{dr} \cdot \frac{n}{100}\ K p.}$$

$$C = \sqrt[3]{\left(\frac{173,000}{D_m}\right)^2 \frac{E\, l_n^2}{\frac{B}{10,000} \times \frac{L}{dr} \times \frac{n}{100}\ Kp}}$$

$$= l_n^{2/3} \sqrt[3]{\left(\frac{173,000}{D_m}\right)^2 \frac{E}{\frac{B}{10,000}\ \frac{L}{dr}\ \frac{n}{100}\ K p}},$$

$$\text{or B)}\quad C = l_n^{2/3} \sqrt[3]{\left(\frac{173,000}{D_m}\right)^2 \frac{E}{\frac{B}{10,000} \cdot \frac{L}{dr} \cdot \frac{n}{100}\ K p.}}$$

For multipolar motors with one set of brushes omit K; for p sets of brushes omit $K.\ p$.

The following illustrations will indicate the application of the above formulæ: 1.—An Eickemeyer motor with drum armature has $n = 800$; $\frac{L}{d} = 0.9$; $r = 2\frac{1}{2}$; $B = 60,000$; consequently, $B \frac{L}{dr} = 24,000$. Current density $= 3700$. To calculate the diameter of an armature of 28 h. p., at 220 volts, we find by horse-power $= \frac{\text{Volt} \times \text{Amp.}}{746}$, $2i = 96$, or $i = 48$. For a current density of 3700 we take two No. 11 wires 90 mils in parallel. $(90 + 14)\ 1.2 = 125 = D_m$. By formula B) we have $\sqrt[3]{\frac{173,000^2}{(125)^2} \cdot \frac{220}{2.4 \times 8}} = C = 282$ and substituting all the known values in formulæ A) we find: $d = 11$ inches and since $\frac{L}{d} = 0.9$, $L = 9.9$ inches.

2.—A Phenix dynamo with ring armature has $n = 1420$; $\frac{L}{d} = 0.85$; $r = 8.2$; $B = 100,300$; $\frac{B\,L}{dr} = 10,400$. Current density, 2040. To calculate d for 13 h. p., 105 volts, we get from a current density of 2040 and for 46 amp. $= i$ a conductor of 150 square mils. Insulation 16 mils, and $1.2 \times (d + 16)$ gives $D_m = 200$.

From formula B) we find $C = 176$ and substituting in A) we find diam. $= 11.15$ in.; $L = 9.4$.

3.—A Brown multipolar four-pole motor with ring armature has $n = 500$; $\frac{L}{d} = 0.52$; $r = 6.5$; $B = 85,000$; $\frac{B\,L}{dr} = 6800$; current density $= 1800$. To calculate an armature for 226 h. p., 625 volts, $4i = 270$ amperes, $i = 67.5$. The current density 1800 requires 19 wires of 52 mils and such a cable with insulation and driving pieces will be $D_m = 330$. From formula B) we find $C = 372$; and substituting this in A), $d = 39$ inches; $L = 20$ inches; radial depth, six inches.

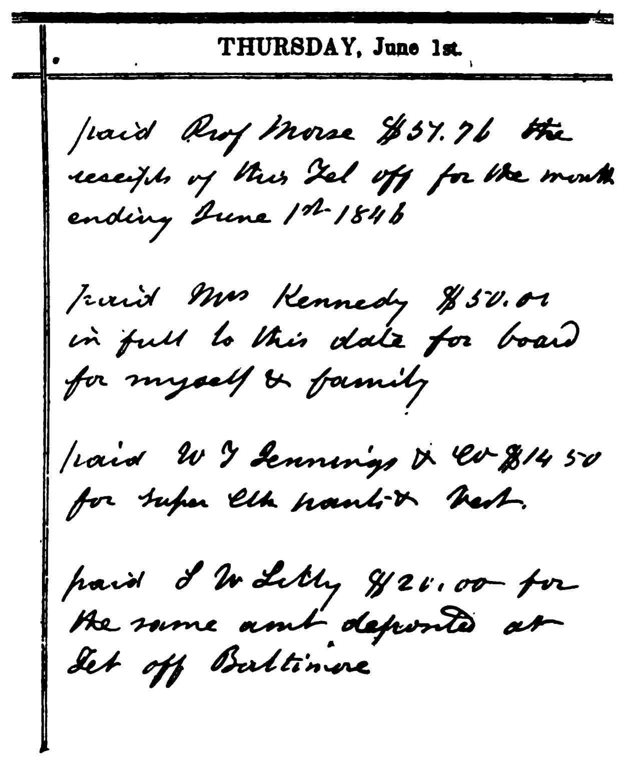
4.—One of Kapp's alternators has $\frac{B\,L}{dr} = 560$; $B = 39,120$; $r = 5$; $\frac{L}{d} = \frac{1}{14}$; current density, 2700; wire, 120 mils, $D_m = 322$, made up by $120 + 20 = 140 \times 1.2 = 168$ and blank part of rim; $p = 7$; $n = 600$; $l_n = 2$. With 80 h. p. at 2,000 volts, $i = 30$ amperes.

To allow for induction we take 2,680 volts and 110 h. p.; $C = 535 \times l_n^{2/3} = 535 \times 1.6 = 850$. Substituting this in formula A) we have $d = 45$ inches.

THE FIRST TELEGRAPH MONEY ORDER.

One of the most striking features of the recent financial disturbance has been the ease and rapidity with which credits have been transferred from point to point to meet the call for money or allay the distrust of depositors. Of course, in some instances the actual transfer of coin has been needed to complete the transaction and redeem the situation; but there can be no question that the use of the telegraph has been of enormous value in supporting confidence and in enabling the gold in the country to render its maximum of service.

This resort to the telegraph for such operations, and on a scale perhaps unprecedented as to magnitude and geographical range, has aroused the inquiry as to when such use began. There are no early official records on the subject, but unless we are greatly mistaken the fac-simile here given furnishes the facts as to the earliest known transfer of money by telegraph. This fac-simile is made from an old diary sheet of blue paper, full size, and is in the handwriting


THURSDAY, June 1st.

paid Prof Morse $57.76 the receipts of this Tel off for the month ending June 1st 1846

paid Mrs Kennedy $50.00 in full to this date for board for myself & family

paid W J Jennings & Co $14 50 for super Clk pants & Vest.

paid J W Lilly $20.00 for the same amt deposited at Tel off Baltimore

Record of the First Telegraph Money Order.

of Alfred Vail. It is now in the possession of a member of the Vail family, to whom we are indebted for it. As will be seen, it bears date on top of the sheet of June 1, 1846, and the item at the foot of the page shows that Mr. Vail paid out in Washington the amount of $20, which had been deposited in Baltimore and an order made by telegraph for its payment to a Mr. Lilly. Fuller details would, of course, have been interesting, but this transaction appears to be the first from which to date our modern system of telegraphic money orders.

ZINC AND CHLORINE BY ELECTROLYSIS.

In a new process proposed for obtaining zinc and chlorine, sulphide of zinc, or zinc blende, is roasted together with an alkali or alkaline earth, with the result that chloride of zinc, and the sulphate of the alkali or alkaline earth are produced. These salts are then made into a cold, saturated solution, which ought to contain them in molecular proportions, and the solution is electrolysed with the production of zinc and chlorine. Zinc cathodes and carbon, or chromium phosphide and anodes, answer well, and ten amperes per square foot of anode surface is a suitable current density.

THE CLAUS DYNAMOS IN THE MANHATTAN OPERA HOUSE, NEW YORK.

Among the theatres opened in New York during the present season is the Manhattan Opera House located in Thirty-fourth street near Broadway. Designed with a view to affording every convenience and comfort in light and in ventilation, the theatre was naturally equipped with electric light throughout. The proprietor of the theatre, Mr. Oscar Hammerstein, in the furnishing of the Harlem Opera House, also owned by him, had, four years previously, installed a Claus 600-light dynamo having a capacity of 300 amperes at 110 volts. This machine had operated so satisfactorily even under heavy overload that it was determined to equip the Manhattan Opera House also with Claus dynamos.

The Manhattan Opera House is equipped with two machines, one of the bi-polar type of 600-light capacity, and a second, a four-pole machine, with a capacity of 1200 lights. The latter is shown in the accompanying engraving, Fig. 1, and the arrangement of the plant complete is shown in Fig. 2. The dynamos, as will be seen, are belted direct to a Weston engine of 200 h. p. A special feature of the multipolar dynamo is its slow speed.

This machine runs at only 350 revolutions per minute, and in still later designs the speed has been brought down to 250 revolutions, so that the armature may be coupled

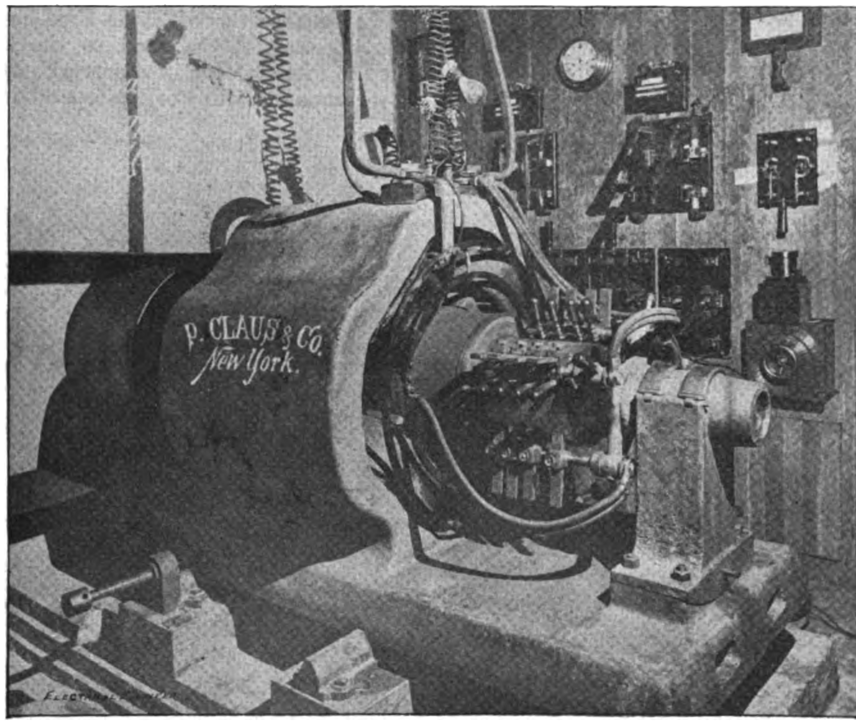


Fig. 1.—Claus Slow Speed Multipolar Dynamo in Manhattan Opera House, New York.

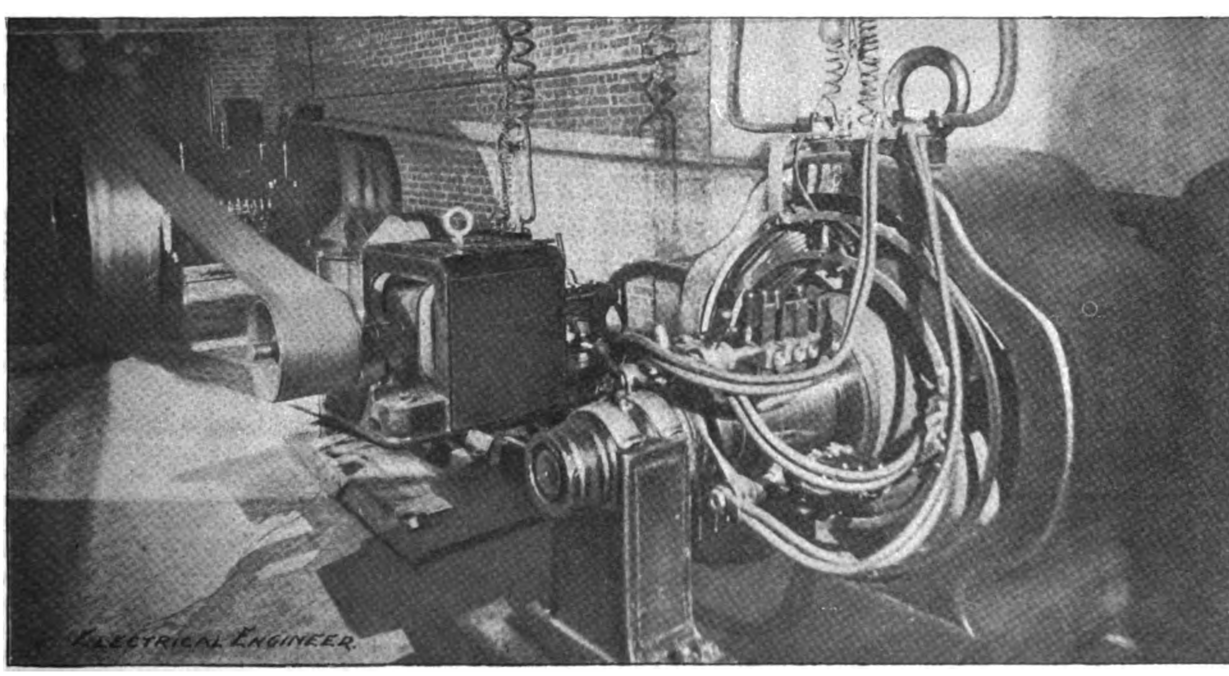


Fig. 2.—Claus Dynamos in Manhattan Opera House, New York.

directly to a high speed engine. There is no service more severe on a dynamo than theatre lighting, in which the fluctuations are frequent and violent; but with the machines here employed there is no difficulty whatever experienced in switching on and off the full complement of lights.

The theatre contains in all 2,000 incandescent lamps, and quite a number of arc lamps. The larger machine runs the stage lights, auditorium and dressing rooms, while the smaller one generates current for the outside lights, hall lights and for the various arc lamps. The entire electrical plant was installed by the P. Claus Dynamo Company and has given most satisfactory results.

EGGER'S AUTOMATIC SAFETY CUT-OUT.

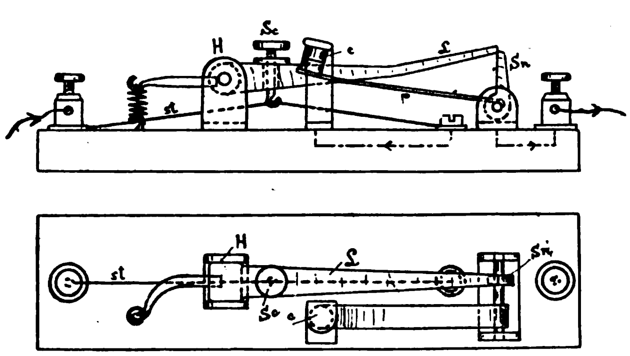
Having in mind the difficulty of securing fuse wire of uniform and reliable character, and also the inconvenience of renewing fuses when blown, Mr. Ernst Egger, of this city, has designed and recently patented an automatic cut-out in which both these difficulties are avoided.

The idea embodied in the apparatus is to pass the current through a strip or wire of expansible metal. If the current is too strong, this wire becomes heated and expands, and thus operates a snapping mechanism for disconnecting the circuit.

The working of the cut-out will be readily understood by reference to the accompanying engravings which show it in two views; *st* is the expansible strip, *sn* is the "snapper" and *c*, the point were the current is interrupted, is provided with carbon-contacts.

If the strip *st* expands, due to excessive current, the screw *sc* is raised, and, being insulated and fixed in the lever L, which is movable on the hinge H, the latter releases the snapper *sn*. As a result the snapper *sn* suddenly drops and with it the spring plate *p*, which carries one of the carbon contacts *c*, whereby the current is rapidly broken.

To put the instrument in working order after such a disconnection, it is only necessary to lift the snapper, and to press it on the point of the lever L. This again makes contact between the plates *c*, and the cut-out is now ready for the next operation. Such a device is able to work between quite wide limits, due to the fact, that the length of the arm of the lever L can be adjusted for different currents by means of the screw *sc*. By changing the material or size of the strip *st*, these working limits can be greatly



Figs. 1 and 2.—The Egger Automatic Cut-Out.

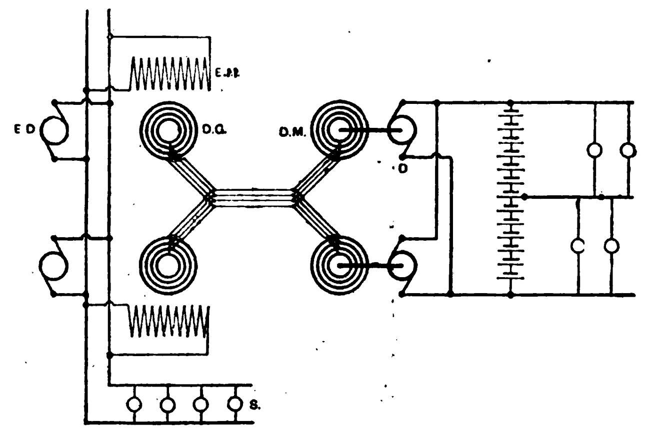
extended, all the other parts of the instrument remaining unaltered.

The engraving represents in full size the first, rather rough working model of this cut-out, and contains, on that account, more parts than an instrument, made in the regular manufacturing way, would possess. Nevertheless, it has worked very reliably and satisfactorily from ½ up to 15 amperes, and between those limits the wire *st* was changed only once; at all other times the mere adjustment of the screw *sc* was sufficient. The wire or strip *st* can be made of steel, brass or a combination of two different metals.

The cut-out can be connected with a local battery circuit and a bell, which circuit will be closed by the movement of the plate *p*. In this way the engineer is at once informed of the working of any cut-out.

ELECTRIC LIGHTING OF BUDA-PEST.

The authorities of Buda-Pest have given concessions to Messrs. Ganz & Co., and to the Austrian Gas Company for the introduction of electric lighting in that city. These two companies will work independently and are under heavy



S. Lighting at Station. E. D. Exciting Dynamo. E. M. Exiting Magnets. D. G. Two-Phase Alternate Generator. D. M. Two-Phase Alternate Motor. D. Continuous-Current Dynamo.

bonds not to combine or to work together in any way; it is thus hoped to insure healthy competition.

The central station of the Gas Company is to be about two miles outside the town, and it is proposed to carry out the transmission by means of two-phase currents. The station plant will at first be laid down with a view of supplying 20,000 8 c.p. lamps, the distribution net-work being equal to a load of 32,000 lamps. The station plant is to consist of two vertical, triple-expansion 500 h. p. machines coupled direct to 1,800 volt, 100-ampere, two-phase dynamos, which will be worked in parallel. The line will consist of two armored lead-covered concentric cables, the fourth conductor acting as a reserve. The two-phase current will be taken to a sub-station, where it will drive motors coupled direct to dynamos, supplying current to the lamps and charging a battery of accumulators of a capacity of about 1,500 to 2,200 ampere-hours, and capable of discharging at the rate of 1,000 amperes.

This installation, which is shown diagrammatically in the annexed sketch, is to be carried out by Messrs. Schuckert & Co., of Nuremburg, who are under contract to have a portion of the installation in working order by the coming winter.

AN INSTRUMENT FOR MEASURING PHASE DIFFERENCE.

Mr. Claude showed in London recently an instrument for measuring the difference in phase between the current in a circuit and the impressed E. M. F. The principle of the instrument is as follows:—When a piece of soft iron, fixed to the end of a spring, is placed before the pole of an electromagnet having a permanently magnetized core and traversed by an alternating current, it is attracted and vibrates with the same period as the current. If the spring also carries a mirror from which a ray of light is reflected on to a scale, the length of the band of light produced will be proportional to the maximum displacement of the mirror. Two such electromagnets are used, acting on the piece of soft iron in opposite directions, and at such distances that they produce the same maximum deflection, one magnet being placed in series with the circuit, and the other joined to the ends of a non-inductive resistance. Under these conditions the length of the band of light is proportional to the cosine of half the angle of lag.

WORLD'S FAIR DEPARTMENT.

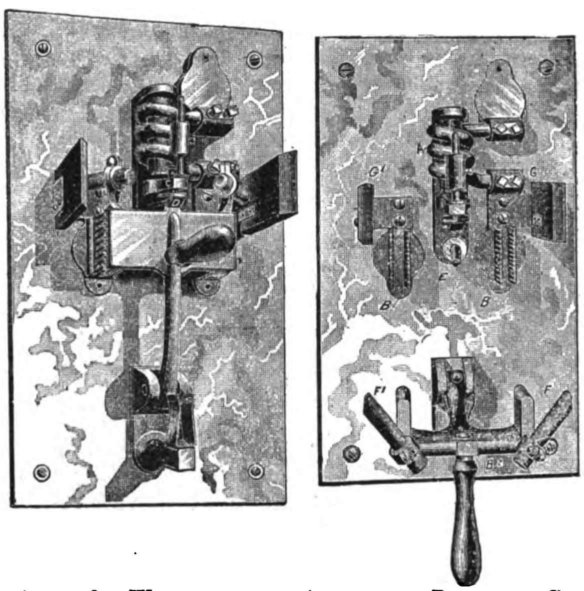
THE WESTINGHOUSE RAILWAY EXHIBIT.

The Westinghouse exhibit in the Electricity Building most nearly complete at present writing is that of the railway department near the southern end of the hall and directly in the rear of the Bell Telephone temple. Here are shown specimens of all the standard railway apparatus made by the company, most conspicuous among which are two large generators, one on either side of the graceful central pavilion. One of these is a "Kodak" of 270 h. p. directly connected with a Westinghouse compound engine with cylinders 16 and 27 inches in diameter and with 16 inches stroke. On the opposite side of the pavilion is a 400 h. p. four-pole standard belt driven dynamo. At one end of the space is a pit, such as is seen in car houses, over which stand a Stevenson car and a Brownell "accelerator" each equipped with standard single reduction motors and series parallel controllers. Steps leading into the pit allow visitors to inspect these from beneath. At the opposite end is a truck built by the Sheffield Velocipede Car Company, of Three Rivers, Mich., furnished with a 30 h. p. single reduction motor in operation; the truck being blocked up to allow the wheels to revolve. Three of these motors are shown on stands near by, the first entirely open and the other two running with their upper and lower fields removed, respectively. Motor details and apparatus are shown, including field coils, standard "E" diverters, built up of sheet iron ribbon and mica, and bolted to the cars; and the new "H" series parallel controller in which several detail improvements in insulation, contacts, etc., have been made although the general design has not been altered.

Part of the Railway Exhibit of the Westinghouse Electric & Mfg. Co.

Field rheostats for generators, a large brush holder, a shunt and series field coil, with the two windings on separate sections of the same spool, and a number of motor and generator armatures are distributed about the space. On a table stands a tank lightning arrester and a set of single, double and triple pole switches of from 30 to 1,600 amperes capacity. The stand in the foreground of the engraving contains railway voltmeters and ammeters, the latter with carrying capacities from 100 to 4,000 amperes, and a number of automatic carbon shunt circuit breakers from 150 to 1,600 amperes. This device is shown open and closed in Figs. 1 and 2 (page 6). It is mounted on a marble base 10x17 inches in size and consists of an electro-magnet, A, below which is its armature, C, connected with a trigger D, that holds the switch closed. A pair of carbon pencils F, F', are so designed that they will continue connection with the carbon plates G, G', for a short interval after the metal jaws of the double-break switch have broken their contact.

A lever carries the jaws and pencils, which are electrically one, and a spring catch receives the lever after it has been thrown back by the small but strong spring, E. The handle is merely a convenience in closing the switch. Connection with the generator main is made back of the marble base. Any desired adjustment for different currents within the range of the instrument, is secured by chang-



Figs. 1 and 2.—Westinghouse Automatic Railway Circuit Breaker.

ing the weight attached to the armature composed of a number of circular metal discs, each marked with the number of amperes which its weight represents.

The solenoid being in series with the main circuit, any increase in the current supplied by the generator causes the strength of the magnet to correspondingly increase until it is able to lift the weighted armature and trigger. This releases the lever which instantly flies out, first breaking the metallic contact—without an arc, for the circuit is momentarily maintained by the carbons—then the final break occurs, and the resulting arc is formed only between the carbon pencils and plates, avoiding injury or disfigurement of the switch.

The pavilion in the centre is handsomely decorated, and is being furnished as a reception room for visiting railway men and others interested in the apparatus and work of the company. It will also serve as the office of Mr. J. W. McCrosky, the electrical engineer in charge of this section of the Westinghouse display.

THE LECLANCHE BATTERY DISPLAY.

The exhibit of the Leclanché Battery Company, of 111 to 117 E. 131st street, New York city, is shown in the engraving on this page. The cells shown are of the well-known make of this company, the "Gonda porous cup," "Axo," "Gonda," "Cylinder" and "Vole;" and, with one exception, require no detailed description, having already been dwelt upon at length in these pages. The "Gonda porous cup" cell is the original form of Leclanché battery with the addition of certain improvements that have from time to time been made upon the old "Disque" model. The "Axo" is intended for physicians' use in office cabinet batteries, etc. The "Gonda" is the battery most highly recommended by the company, who claim for it particular merits for telephonic service, and, in fact, wherever open circuit batteries are required. The "Cylinder" cell is largely used in France, where its good work and freedom from faults has, it is said, exceeded even the expectations of its makers. It has the advantages of large surface, small internal resistance, and unusual capability to depolarize itself after short circuit or hard work.

The "Vole" is the latest cell introduced by the company and is especially adapted to electric gas lighting, etc. The negative electrode consists of a carbon, having six vertical wings, over which is stretched a bag so as to form pockets between the wings for the reception of the depolarizing compound. It is provided at its upper end with a carbon rod bearing a screw thread. This rod passes up through the jar cover, its thread engaging with a corresponding thread in the latter, which holds the electrode suspended in the jar. The cover screws down on the neck of the jar and the cell is thus rendered water-tight and can be shaken about or moved from place to place without danger of spilling the liquid. On the top of the cover and around the carbon rod is a collar threaded on the outside. A cap, of the same material as the cover, screws down on this collar completely covering the top of the carbon with its connection, and shielding the latter from dirt and corroding influences. This cap also holds the connection to the carbon by continuous spring pressure, preserving at all times a perfect contact which cannot be loosened until the cap is removed. The zincs are semi-cylindrical, tapering from the bottom upward; an arrangement which allows the cell to depolarize itself much more readily than when the negative element is surrounded along its entire length by the zinc. They are attached to the bottom of the cover by zinc screws, which pass through them and also through the zinc strip which connects them. One of these screws serves as a binding post on the top of the cover. The zincs may be thrown out of connection and only one used wherever a very low internal resistance is not an object. In such case there is of course less consumption of zinc and less quantity of current developed by the cell when in action.

The exhibit is a very attractive one, and stands near the middle of the east gallery. It is in charge of a small boy who dusts it gently each morning and then conscientiously goes away. He says, modestly, that he knows nothing about electricity and is only employed to keep things clean,

Leclanché Battery Co.'s Exhibit, World's Fair.

receiving his orders from the factory in New York. It is but due to him to add that his part of the work is creditably performed, but the value of the exhibit is not so great as it might be were some competent person constantly on duty to explain the features of these excellent and famous batteries.

THE GAMEWELL FIRE AND POLICE ALARMS AT THE FAIR.

The Gamewell Fire Alarm Telegraph Company, of 1½ Barclay street, New York, have a very comprehensive, as well as most attractive exhibit of their fire alarm and police telegraph systems in the east gallery of Electricity Building. The company have followed the business of furnishing municipal telegraphs for nearly forty years, so that the apparatus has had time to become pretty thoroughly known and cannot well be described under the head of "electric novelties." The illustration gives a good idea of the appearance of the space with its office and fire tower and the police and fire boxes connected with their indicators. Here is shown an automatic, non-interference, six-circuit repeater with switchboard and a galvanometer for each circuit indicating the pressure of current, as well as a ground detecting galvanometer for testing. The engine house equipment consists of gongs both plain and combined with indicators, and also a chief's "tapper," a small signal gong for the chief's house giving him private intelligence of the location of a fire.

On posts about the space are non-interference boxes. Some of these are operated electro-mechanically by the simple disconnection of the hook, all other boxes on the line being shunted out while the one from which the first alarm is sent is operating. Others have a keyless door with a lever on the outside and a loud warning bell that rings when the lever is pulled calling the attention of officers and passers by; and, should the alarm be false, leading to the detection and arrest of the person giving it. Tower strikers from the smallest to the largest are shown, one with a 220 pound bell that tries the souls and tympanums of all who are compelled to be within its range when it is exhibited. The largest is intended for a 10,000 pound bell, but fortunately the bell is wanting. It was thought to be too noisy for Chicago.

Especially interesting is a central office system consisting of relays and signal lines in connection with a 16-pen multiple register for receiving the alarms and two manual repeaters for transmitting them from the central office to the engine houses. These are connected with a "dulcimer" to inform the operator should any line be open. The "dulcimer" consists of a series of bells tuned to the notes of the musical scale, each operated by a separate line. The bells are struck in serial order if all the lines are acting properly, but should a note be dropped it indicates that the corresponding line is out of order and must be attended to. A number of plain boxes for villages, factories, asylums, etc., are also shown, as is a complete police telegraph system with a receiving register provided with a time stamp giving the day, hour and minute of each call. A repeater for sending the alarms to the patrol stable is also connected with an indicator and gong registering the numbers of the boxes from which they were sent.

The company have even a better exhibit than this in the use of both their fire and police systems throughout the Exposition grounds. In order to test either one at any moment it is only necessary to set a building on fire or commit some small crime in the presence of a guard; you are arrested while you wait. Mr. E. B. Chandler, the Chicago agent for the company, has the direction of both the exhibit and the installation of the working apparatus. There is no more interesting exhibit of practical apparatus in the whole Electricity Building than this, which illustrates how much in a single field of work electricity has done to promote public safety and conserve public peace and prosperity.

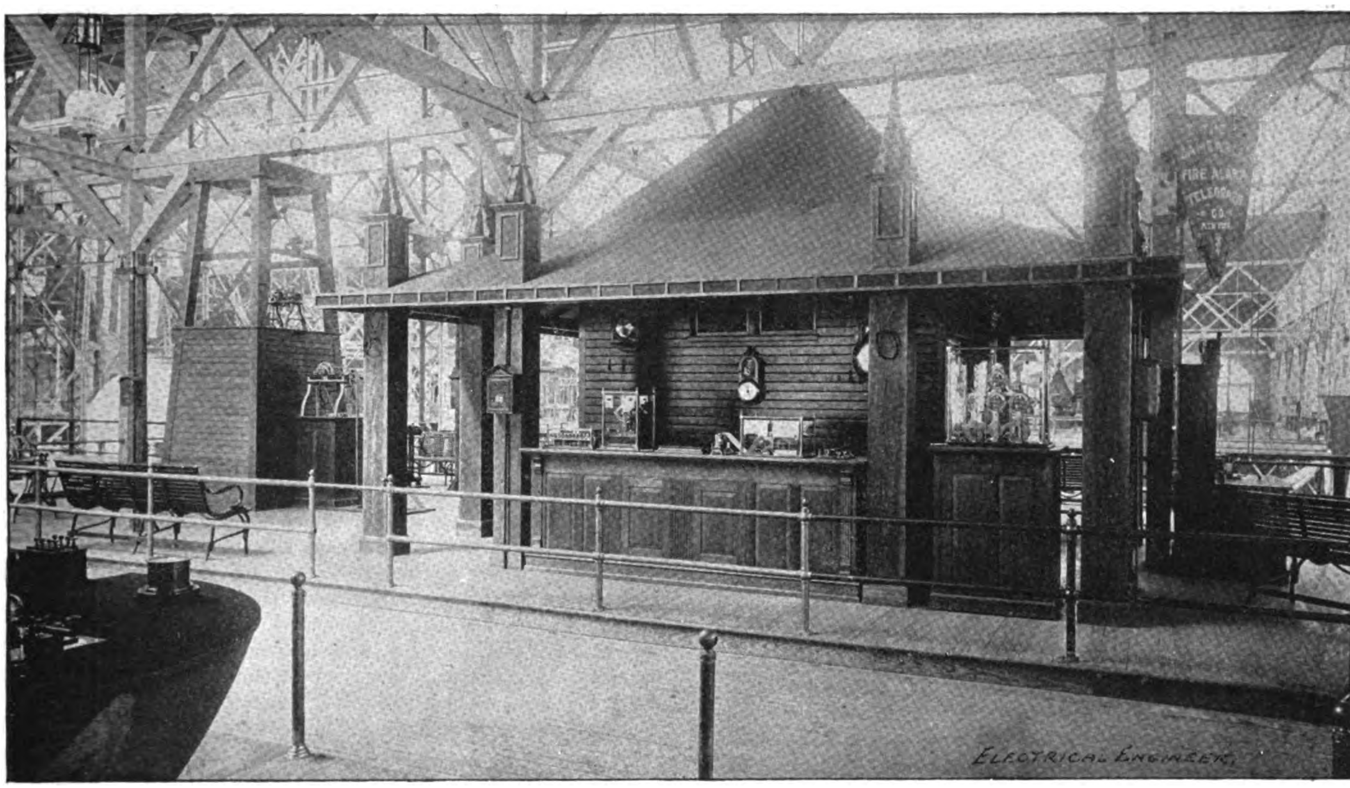


Exhibit of the Gamewell Fire Alarm Telegraph Co., World's Fair.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES AT THE FAIR.

The annual meeting of this Association will be held as usual, in spite of the expectation in many quarters that it would be abandoned in view of the absorption of the Edison interests by the General Electric Company. The meeting is to be held in Chicago on Tuesday, August 8, and the delegates will be specially accommodated at the "Rochester," a new hotel on the European plan, near Lake Michigan, at South Park avenue and Twenty-third street. The convention will possibly hold its sessions on the World's Fair grounds.

MR. EDISON'S "ALBERT MEDAL" AT THE WORLD'S FAIR.

Although Mr. Edison has made no personal exhibit at the World's Fair, his work is to be seen there on every side, embodied either in special features or in the fine exhibits of companies operating under his patents. Among such corporations is the North American Phonograph Co. which is making a very attractive and interesting display of the phonograph, and which has also had the happy idea of securing from Mr. Edison, as an additional feature in its exhibit, a few of the innumerable medals, awards, diplomas and autograph letters from distinguished men, that have been accumulating the last ten years. With Mrs. Edison's help, this idea has been carried out to a certain extent, and some very interesting letters will thus be on view in the company's space, including the Albert Medal awarded to Mr. Edison during the session of 1891–92 by the Society of Arts. We have availed ourselves of the opportunity to reproduce the medal here from the electrotypes made of it in obverse and reverse, our illustrations being about half the size of the original medal.

The correspondence accompanying the medal is also very interesting. The first letter, dated October 25, 1892, is signed by the Prince of Wales, as President of the Society of Arts, and states that the medal was instituted 30 years ago in honor of his father, the Prince Consort, since which time it has been awarded to men of the very highest scientific distinction in all the countries of the

The Edison "Albert Medal," Half Size.

world. The Prince adds: "It is a source of satisfaction to me that the last name on this distinguished list should be that of one who has done so much for the advancement of science as yourself." The second letter is from the British minister, Sir Julian Pauncefote, to whom the Prince gave the medal for conveyance to America, and, who, echoing the Prince's sentiments in a very charming and graceful manner, speaks of the "inestimable benefits which you have conferred on all nations." The third letter is from Secretary of State Foster, to whom the medal was then entrusted, and who informs Mr. Edison that he can have it on paying the express charges.

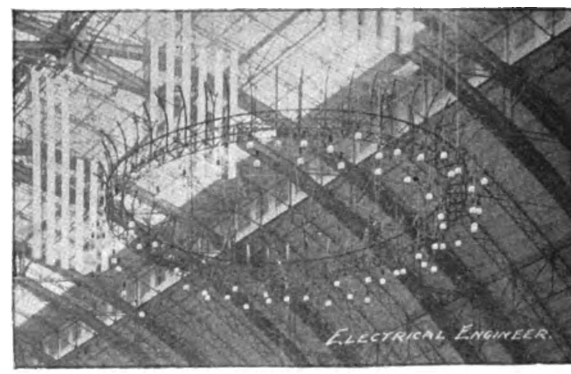
Around the rim of the medal runs the following inscription:—

"Session 1891–2.—Thomas Alva Edison, in recognition of the merits, of his numerous and valuable inventions, especially his improvements in telegraphy, in telephony, and in electric lighting, and for his discovery of a means of reproducing vocal sounds by the phonograph."

Another very interesting correspondence is that between Mr. Edison and Lord Kelvin. Under date of April 10, 1892, Mr. Edison sent Lord Kelvin the record of the litigation in the suits to protect the Edison incandescent lamp. The letter is a holograph. In one passage Mr. Edison says:—"I expect that the already long list of the claimants for the honor of making lighting by incandescence a practical reality will be still further increased as time goes by. Here in these volumes, however, we have, so far as pertinent in America, the sworn testimony of many eye witnesses taken when memories are fresh." Lord Kelvin accepts the volumes and in one of his letters adds the hope that the result of the litigation "will ultimately be all satisfactory to Mr. Edison, to whom we owe so much for all he has done of benefit to the world, not only in electricity, but in other large departments of inventions."

LIGHTING THE MANUFACTURES BUILDING.

In The Electrical Engineer of March 29, 1893, an illustrated article appeared descriptive of the electric lighting in the Manufactures and Liberal Arts Building, and of



One of the Arc Light Coronas, Manufactures Building.

the huge arc light coronas suspended in the roof of that vast hall. A view is here given, taken from a recent photograph, of one of these coronas, which are doing excellent work, and the lighting from which is said to be more than satisfactory.

In view of the stupendous character of the work, much doubt was felt at first by some engineers as to the results obtainable with these coronas, but it may be said that the lighting has proved most effective and has itself become one of the sights of the Fair. The building lighted is 1687 feet long, 787 feet wide, with an arched roof 368 feet wide and 210 feet high.

THE BRYANT ELECTRIC COMPANY'S EXHIBIT.

A month or more ago, a short notice appeared in this department of the display of the Bryant Electric Co. of Chicago in the southeast corner of the second floor of Electricity Building. I am now able to show an engraving of the finished exhibit designed and executed by Mr. Edward R. Grier, who has become associated with his brother, Mr. Thomas G. Grier in the local management of the company. The high oak frame with black mat contains graceful designs made of Bryant switches, sockets and cut-outs, all of which are far too well known to require detailed

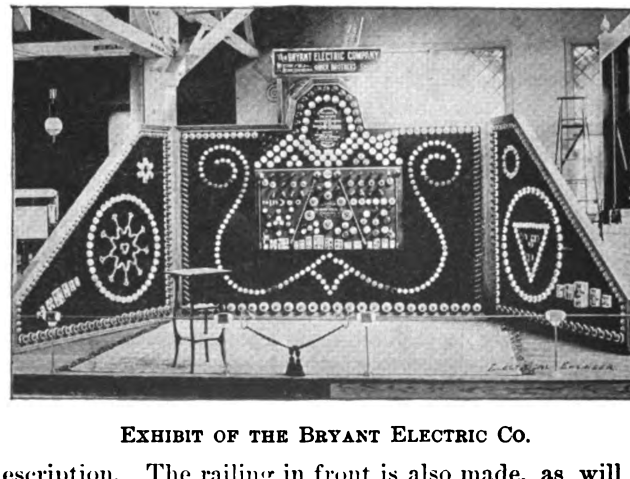


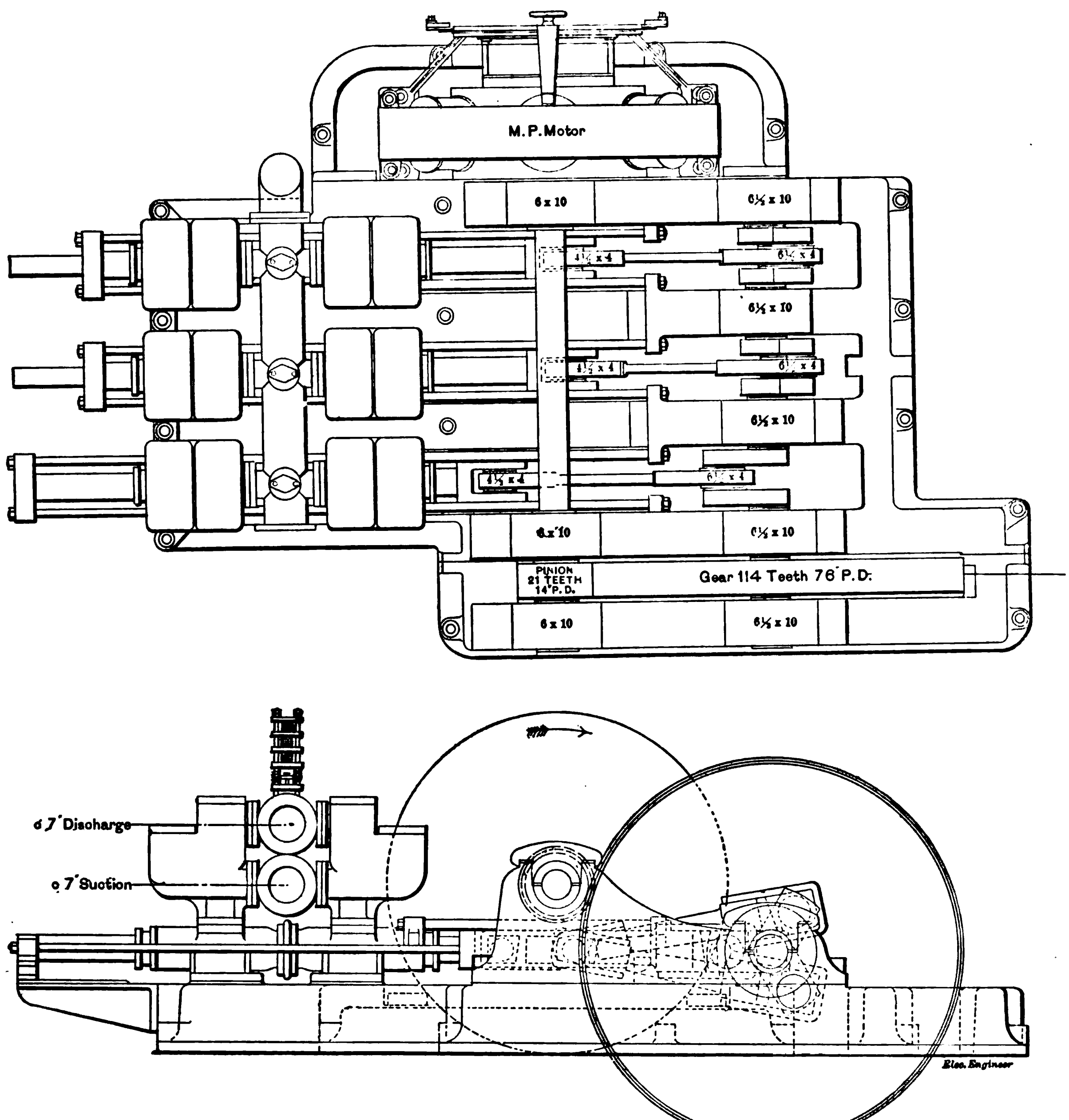
Exhibit of the Bryant Electric Co.

description. The railing in front is also made, as will be noticed, of brass tubing, fixtures, and sockets, while the case in the centre of the large frame contains more cut-outs and a variety of fuse blocks. The display is very pretty and adds to the brightness of the part of the gallery where it stands.

THE GENERAL ELECTRIC MINING AND POWER TRANSMISSION EXHIBIT.

Directly west of the great Tower of Light in the Electricity Building is the space devoted to the mining machinery and model power transmission plant of the General Electric Co. In the centre is a tank 12 feet deep and 16 in diameter, about which are ranged eight pumps all in operation and electrically driven. The most remarkable of these is that shown in the working drawings, Figs. 1 and 2, which stepdown transformers reduce the potential to 110 volts at which pressure it operates a number of three-phase motors. One of these drives a reciprocal drill generator with rotating brushes, which operates two drills mounted on large blocks of stone at the rear of the space. These make too much noise to be used very much, but never fail to attract notice when they are in operation.

On the opposite side of the tank from the large triplex pump is a duplex double action mine sinking pump and



Figs. 1 and 2.—Blake Triple Cylinder Power Pump Driven by Thomson-Houston Multipolar Motor.

a double-action triplex pump, made expressly for this exhibition. It is built of gun metal in all parts subject to water pressure or shock and will elevate 450 gallons a minute to a height of 650 feet at the pressure of about 320 pounds. This is directly connected with a six-pole motor with iron-clad armature on a 220 volt circuit running at a speed of only 275 revolutions a minute, and drives a Pelton water wheel directly connected with a three phase generator. Current from this machine at 300 volts goes to step-up transformers where it is raised to 6,000. It then traverses a short line, which in practice would be many miles in length, at the end of motor in an iron case so constructed as to work perfectly well even when entirely submerged, and lift 200 gallons a minute 500 feet. At one side—the right in the engraving, Fig. 3,—is a vertical triplex pump driven by a ten h. p. motor, and opposite this is a horizontal triplex pump mounted on a truck and connected with a 15 h. p. motor. Between this and the tank are two others, one rotary belt driven, and the other centrifugal and directly connected with an iron-clad motor. There are also two smaller triplex pumps to furnish water to the diamond drills. At the rear of the enclosure will be seen a 120 h. p. hoist with a 6-foot drum, driven by a 4-pole series type

motor with intermediate gearing, and near this a 15 h. p. hoist driven by a railway waterproof motor, while another motor of the same type operates an air compressor. Three mining locomotives stand on tracks near by. They are of 20, 30 and 60 h. p. and have gauges of 24, 36 and 30 inches, respectively. The 60 h. p. one has been in service for six months in a coal mine. Here is also an electrical coal pick, or mining machine, and a coal channeling machine driven by an iron-clad motor. A Baker blower directly connected with an Edison motor of 22 h. p. completes this part of the display. All the machines mentioned are controlled from a switchboard near the centre of the space.

At one side near the front is a 100 kilowatt three-phase generator with fixed armature and rotating fields, and on the other side a hoist driven by a small three-phase motor, while at the extreme left and right, respectively, are the primary and secondary stations of the synchronous plant with their transformers and switchboards with the necessary station instruments.

The photograph from which the engraving was made was taken from the roof of the Phœnix pavilion at the base of the Tower of Light, and gives an excellent idea of this most interesting section of the General Electric Company's exhibit.

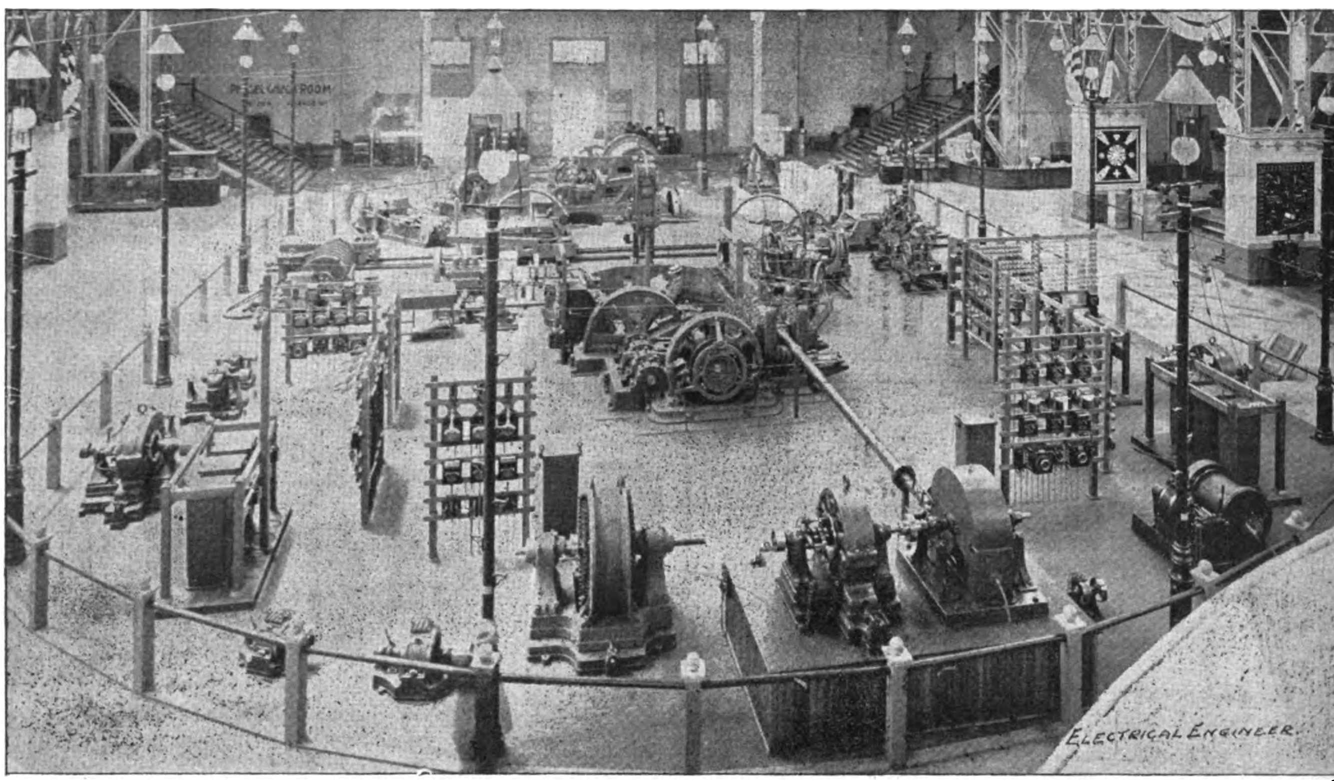


FIG. 3.—GENERAL ELECTRIC MINING AND POWER TRANSMISSION EXHIBIT.

EARLY FERRARIS ROTARY CURRENT APPARATUS LOST.

MR. W. J. HAMMER received on June 23, the following cable dispatch : "Apparatus sunk, harbor Genoa. Letter follows." This refers to some of the apparatus with which Prof. Ferraris demonstrated the rotary field by means of alternating currents of different phases, which was on its way to be exhibited in the rooms of the American Institute of Electrical Engineers at the World's Fair. Six pieces were contained in the box : No. 1. A vertical copper cylinder, rotating in the field produced by two crossed coils; No. 2. The first Ferraris rotary field motor with horizontal axis and copper armature ; Nos. 3 and 4. Two iron cylinders to be substituted for the copper one in No. 2; Nos. 5 and 6. A rotary field motor with an iron magnetic circuit, and an iron cylinder for it. In a recent letter Prof. Ferraris said that he felt it his duty to exhibit these instruments at the Fair, and in advance thanked the Institute for the care of them and for their safe return.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AT THE FAIR.

THE World's Fair headquarters of the American Institute of Electrical Engineers are being rapidly put into habitable condition. The rooms are at the south end of the Electricity Building and will be fitted up handsomely and comfortably for the reception of members, who are urged to use them in all respects as they would their clubs. A telegraph office and a long distance telephone, to say nothing of a fire-alarm and police and ambulance calls will add to the comfort and convenience of those requiring them. Mr. W. J. Hammer, chairman of the ways and means committee, is now at the Fair in company with the secretary, Mr. Ralph W. Pope, who will remain in charge throughout the exposition. A valuable and interesting historical loan collection of electrical apparatus will also be on exhibition.

MESTON MOTORS AT THE FAIR.

THE ELECTRIC APPLIANCE COMPANY'S exhibit of Meston alternating current motor applied to the operation of a sewing machine continues to attract considerable attention and keeps a crowd around their World's Fair space. The outfit is certainly a very complete and compact affair, and the ease with which it can be controlled leaves nothing to be desired.

THE BEAUTY OF THE ELECTRIC FOUNTAINS.

THE *Evening Post's* dispatch of June 26 from the World's Fair says :—The fireworks were omitted on Saturday night, but their presence would simply have embarrassed the visitors with riches, for the illuminations were grander than they have ever been. The Administration Building and the whole Court of Honor were fairly ablaze with thousands of incandescent electric lights, and for the first time two electric fountains were playing. The water shoots up in a fine spray from these fountains, reaching at times fully 60 feet in height, and changes from one color to another. The effect, especially when viewed from a launch or gondola on the basin, is gorgeous indeed.

THE

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XVI. NEW YORK, JULY 5, 1893. No. 270.

TRANSATLANTIC TELEPHONY.

IN the admirable presidential address delivered before the London Institution of Electrical Engineers a short while since, Mr. Wm. H. Preece, F. R. S., drew attention to the fact that he had recently devised a new form of cable which would probably quadruple the rate of cabling across the Atlantic, and went so far even as to say, with all confidence, that there was no theoretical reason whatever why London should not talk with every capital in Europe, while it was not impossible to speak even across the Atlantic. Utterances like these coming even from an authority such as Mr. Preece unquestionably is, might still be looked upon with the distrust which has, and rightly too, attached to like expressions in the past. That this doubt as to the feasibility of telephoning across the Atlantic is justified in the light of past experiments will, we think, be generally acknowledged. We may even recall here, without disparagement, we trust, the experiments made by the late Prof. Moses G. Farmer, who, we understand, even up to the time of his death cherished the idea of solving this problem, but whose experiments carried out on an actual cable some years ago gave negative results. That the scheme foreshadowed by Mr. Preece in his inaugural address is being actively worked at appears from the fact that the English Government has made a grant of $2,500,000 to develop long distance telephony, a part of which sum is being devoted to experiments having actually in view the carrying out of the scheme of telephoning across the Atlantic.

From the recent noteworthy remarks of Mr. Alexander Siemens at the London Society of Arts, we learn, as might have been expected, that experiments with such cables are extremely costly and involve a great deal of time, trouble and knowledge, and these seemed to him good reasons for withholding from publication the results of the work which has been accomplished. In this, however, it would appear that he is not sustained by Prof. Silvanus P. Thompson and others, who insist that such experiments made at the public expense should be published; we must, therefore, await with patience the possible publication of these results. In the mean time we shall probably have some light shed upon the subject, judging from the announcement that Prof. S. P. Thompson will read a paper on "Ocean Telephony" before the Electrical Congress in Chicago. It is gratifying to know that work is being done in this direction, and to Mr. Preece must be given the credit of lending his aid and influence, and bringing the courage of his convictions to bear on the carrying out of a scheme which cannot but appear visionary to many who know the difficulties to be contended with.

ELECTRIC CAR HOUSE CONSTRUCTION.

THE improvements which have been wrought in central station construction since the adoption by the New England Fire Underwriters Association of a standard specification for such buildings, have been so great that the rules laid down by that admirably conducted Association have been closely followed by many other insurance bodies in various parts of the country. Now that the central station has been reduced to standard rules, there arises another important adjunct or class to be standardized and that is the railway car house. Evidently the contents of a crowded structure of this nature may represent a money value quite equal to, if not greater than, that of the central station apparatus itself, and the recent destruction —somewhat unexplained—of such structures with their contents has forced the question of their better protection upon the underwriters. The trouble almost invariably encountered in car house fires is the difficulty, if not impossibility, of removing the cars sufficiently fast to prevent their destruction. In the article on this subject, in our current issue, by Mr. Alfred E. Braddell, an expert, the arranging of car house tracks on grades is discussed and some of the objections to the system are pointed out. It would seem that the adoption of a moderate grade would be an easy way out of the difficulty. The objection to the deterioration of the brakes owing to their constant application could be easily avoided by the use of easily removable and controllable blocks under the wheels. The subject is one of considerable importance to all street railway companies, and we would be glad to open our columns to any suggestions bearing on it.

Calculating Armatures.

WE give on another page an interesting example of that ever-existing tendency of the so-called practical man to bring the calculations required for the correct design of dynamo electric machinery within the category of some older or better known form of prime mover or generator of energy. The calculation of the diameter and length of an armature given by "Steam Engineer" is based on the analogy between the torque at the periphery of the armature and the pressure on the piston of the steam engine. The novelty of the presentation adopted by the author, will, we are sure, prove of interest to many of our readers.

ELECTRIC RAILWAY DEPARTMENT.

THE UNIVERSAL ELECTRIC COMPANY'S CONDUIT RAILWAY SYSTEM.

WHATEVER may be the cause of the agitation still met with against the overhead electric railway trolley wires, whether on the ground of danger to life, or for aesthetic reasons, the fact remains, that many still insist on the removal of the overhead wires. Inventions are usually the result of public demand or necessity, and the persistent clamor for an electric conduit railway system has found its response in the numerous devices intended to convey the current to the cars from below the surface of the street. We have at various times described various methods having this object in view, some proposed, and others actually tried in an experimental way, and we are enabled this week to present to our readers another system which deserves attention on account of its simplicity and the novel features which it possesses. The system has been applied to a piece of track about one-fourth of a mile in length situated at Coney Island, and embracing within its length a curve having a 60-foot radius. Through the kindness of Mr. Albert Stetson, general manager of the Universal Electric Company, of this city, who are exploiting the system, we were recently afforded every opportunity of witnessing its operation.

The methods here adopted are based primarily on the inventions of Mr. G. T. Woods, and have been carried out to their present practical consummation by a number of others including Mr. C. S. Van Nuis, G. H. Dale, J. J. Green, and Mr. Albert Stetson. The broad idea involved in the construction is to provide a current conductor which shall be placed in connection with the motor on the car at successive points on the line during the passage of the car, and so that, as the car passes on, each point of contact shall become disconnected from the line. This is carried out by attaching to the car a contact shoe for the purpose of making connection with a series of short switch-arms placed in contact with the conductor.

The system is shown diagrammatically in the accompanying engraving, Fig. 1. Here, it will be noted, the generator G supplies the current to the conductors which are run on each side of the conduit forming the positive and negative leads, and thus avoiding all ground returns, and overcoming the difficulties which have been encountered with this method of operation. At intervals of 8½ feet there is placed a series of switch boxes, those on one side of the contact box staggered with those on the other side. Each of these boxes, which will be described presently, contains a switch connected to a lever arm which projects into the conduit so as to range in the path of the contact shoe on the car. This shoe is illustrated in the diagram, Fig. 1, and is shown as making contact with two switch arms on one side and one on the other. The length of the shoe is such that the contact on one switch is made before that on the preceding is broken so as to avoid sparking.

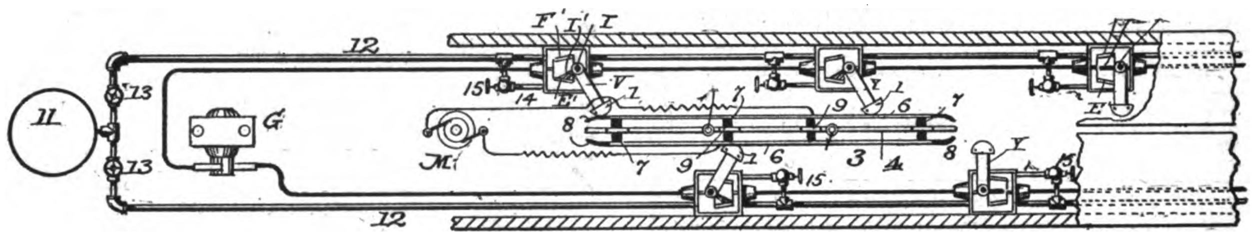


FIG. 1.—UNDERGROUND CONDUIT RAILWAY SYSTEM OF THE UNIVERSAL ELECTRIC CO.

The construction of the boxes and their functions will be readily understood from an inspection of Figs. 2 and 3, which show the switch box complete, and with the top removed showing the brush contact. From these it will be seen that the main conductor, consisting of an insulated lead-covered cable is carried along the conduit and at each switch is bared for a space of two inches. Around this bared space there is placed a brass clamp with two upwardly projecting tongues; between these two tongues there is placed a brush which is attached to a vertical spindle passing upward through the box, and provided at its upper end with a lever arm which projects into the conduit, and meets the shoe in its passage through the conduit. In its normal position the brush in the box is maintained centrally between the brass tongues, so that there is no connection and hence no current in the arm projecting into the conduit, the brush in the box being maintained in its central position, by means of a spiral spring. Upon the passage of the shoe through the conduit the lever arm is moved through an angle sufficient to bring the brush in contact with one of the vertical tongues of the clamp connected to the main conductor, with the result, that the current from the latter is led up into the lever arm, passes into the shoe, and thence to the motor on the car; thence it finds its way into the conductor on the other side of the shoe, and passes into the lever arm of the opposite switch box which is similarly deflected, and which permits the current to pass into the conductor back to the generator.

The illustration, Fig. 1, shows the shoe in the position just

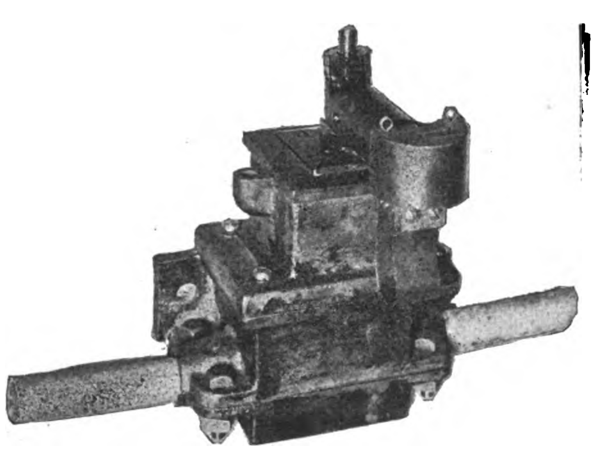


FIG. 2.—THE AUTOMATIC SWITCH BOX, CLOSED.

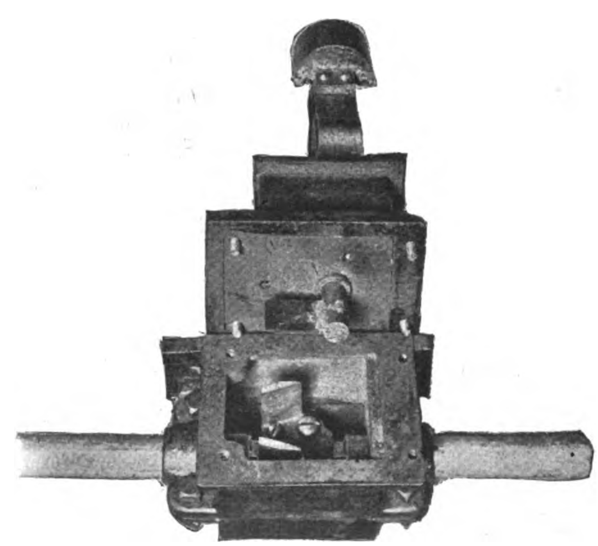


FIG. 3.—THE AUTOMATIC SWITCH BOX, OPEN.

described. In order to permit of the car being reversed without injuring the switch arms, the heads of the latter are made movable and held in position by sleeved helical springs. The arms can be moved in either direction so that the brushes may make contact with the tongue in either direction of the motion of the car. The head of the lever arm is designed so that it can be renewed and removed.

In order to insure insulation of the line, the boxes are filled

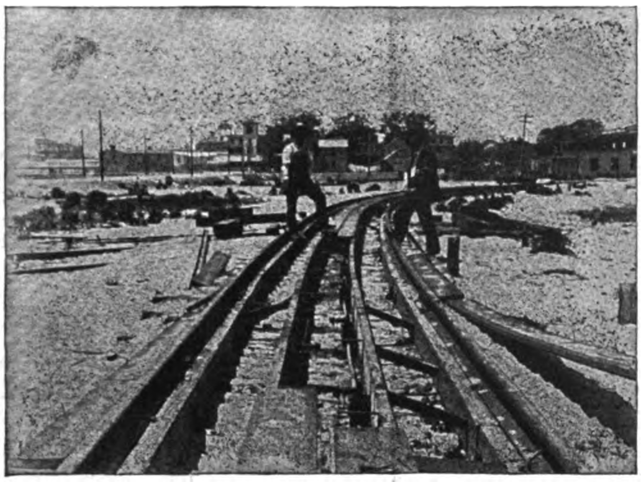


FIG. 4.—SECTION OF RAILWAY CONDUIT.

with solid paraffine up to a little below the level of the brush which makes contact with the vertical clips. Above this point the boxes are filled with paraffine oil which is continuously supplied by a reservoir L, Fig. 1, and piping which runs continuously through the conduit and communicates with all the boxes. By keeping a small pressure on the oil reservoir *l l*, the boxes are continually kept filled, and any leakage is at once made good. The spindle passing up through the switch box is provided with a stuffing box, and the lead-covered cable as it enters the side of the switch box is also thoroughly packed so as to keep out moisture. Under these conditions it is obvious that even a flooding of the conduit would cause practically no leakage, since in their normal condition the switch lever arms are not in contact with the current conductor.

The shoe carried by the car which is illustrated in Fig. 5, is very ingeniously constructed, being so designed that it is able to take all curves without the slightest strain; it is so mounted on the car, that in case the latter should leave the track the shoe would slide out of its seat and would be left in the slot undamaged, so that it could be immediately attached to the car when the latter is again placed upon the rail.

The conduit, a view of which is shown in Fig. 4, is extremely simple and ought to be very cheap to lay down; as far as the cost of the switch boxes is concerned, it is stated that it will not exceed the cost of overhead line construction.

The experiments which we witnessed were carried out under the supervision of Mr. Albert Stetson, assisted by Mr. A. S. Brown,

FIG. 5.—THE CONTACT SHOE.

and though the test of time is still wanting, the results already accomplished would appear to afford strong confirmation of the practicability of the system. We shall watch its progress with much interest.

THE BROOKLYN RAILROAD COMPANIES GET FRANCHISES.

MAYOR BOODY of Brooklyn approved recently the resolutions adopted by the Aldermen by a vote of 18 to 5 granting valuable railroad franchises to the Brooklyn City Railroad Company and the Nassau and Kings County Electric Railroad Companies, and rejecting the application of the Union Street Railway Company.

The provision for the payment of a certain percentage on the gross earnings of the companies on the routes included in the grants had been embodied in the resolutions at the suggestion of the Mayor. The Union Street Company professed its willingness not only to be taxed on gross earnings, but also to pay into the city treasury at once from $12,000 to $20,000 for each mile of the routes.

The subject is still being stirred up and investigated, chiefly in the interest of the Union Co. There is a chance of interesting revelations.

LOOK ON THIS PICTURE AND ON THAT.

THE following is from the *New York Times* of June 29:

Don't Want The Trolley Road.

ASBURY PARK, N. J., June 28.—Vice Chancellor Bird has granted a rule to show cause why an injunction should not he issued against the Asbury Park and Belmar Railroad Company to prevent that corporation from constructing or operating their road on the macadamized road between here and Belmar.

The following is from the *Asbury Park Journal* of June 17:

Public Health First.

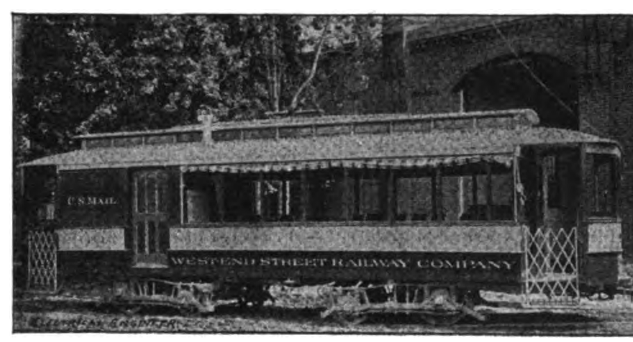
The Board of Health, in its regular course of business, takes up one class of sanitary improvements from time to time. At present particular attention is being paid to the 150 stables throughout the town, and the Board has laid down a set of rules which must be obeyed, otherwise the owners will be subject to legal measures.

The purpose of the Board of Health is that all stable manure shall not rest upon the ground, but shall be placed in pits or vaults having water-tight floors. The reason of this must be obvious to everyone having the preservation of the public health foremost in mind. All the stable owners will be asked to conform to the requirements. The Board will give extra attention to the nine livery stables, so that there may be no violations of common sense and reasonable regulations.

A people that prefers manure to electricity deserves all that it gets of the former.

ELECTRIC STREET RAILWAY MAIL SERVICE.

FROM time to time we have made note in this department of the introduction of mail cars on the electric street railroads. The most notable instance of work of this nature has been found at St. Louis, where the local collections and deliveries have been greatly expedited. We illustrated a few months ago the special mail cars used there, and we now show another neat form in use on



TROLLEY CAR WITH MAIL AND EXPRESS SERVICE.

a suburban road, where advantage has been taken of a long car to devote a portion at one end exclusively to mail and express service. Such a system is found very useful and it is steadily growing in popularity.

A $15,000,000 MORTGAGE.

A DISPATCH from Jersey City, of June 24, says:—It transpired yesterday that in making its $15,000,000 mortgage to the Manhattan Trust Company of New York, the Consolidated Traction Company of this city and Newark deposited with the trust company 9,989 shares of the Jersey City and Bergen Railroad Company, 6,000 shares of the Newark Plank Road Company, and 991 shares of the Jersey City, Harrison and Kearney Railway Company. The shares are to be returned from time to time as the road is built. The mortgage was signed by E. F. C. Young, R. F. Bower, and T. G. George for the Consolidated Traction Company, and by John Kean, Jr., and C. H. Smith for the Manhattan Trust Company.

STOPPING IMPORTANT WORK IN JERSEY.

A DISPATCH from Jersey City of June 24 says: The Jersey City and Bergen Railroad to-day undertook to erect poles and wires on Newark avenue for a trolley branch of its road. The work was stopped by the police under command of Capt. F. T. Farrier of the First Precinct. President Thurston says the law gives the company authority to erect poles, and that the police have no authority in the premises. He says he will invoke the aid of the courts. Capt. Farrier says the work was stopped because the permission of property owners had not been obtained.

AN IMPORTANT PROBLEM IN ELECTRIC CAR-HOUSE CONSTRUCTION.

BY ALFRED E. BRADDELL.

Owing to the many, and disastrous, fires which have occurred in electric railway car houses, the matter has been seriously discussed by the insurance companies, as to the best means to lessen the fire hazard. With this end in view the inspectors of the Association with which the writer is connected (the Underwriters' Association of the Middle Department) have been deputed to compile specifications for a standard car house.

It has been, I think, fully demonstrated that the great difficulty at the time of fire is the inability to remove the cars from the building, so that in many cases they have been entirely destroyed. To get over this difficulty it has been suggested to specify that the tracks be constructed on a gradient falling toward the entrance. If such is decided on, the next question is what percentage of grade should be specified.

This is a question the writer wishes to ask of the many readers of your valuable journal. A number of well-known electrical engineers and railroad operators have been approached on this matter, with not very satisfactory results. The engineers suggest not less than a three per cent. grade, but this is objected to by the operators for many reasons, stating that the brakes would have to be continually applied, which they claim would cause their deterioration; also that with such a grade the cars could not be kept under proper control, being liable to move unexpectedly, perhaps injuring life and resulting in a suit for damages.

Where then are we to strike the happy medium? The vital point is to have some method for rapidly removing the cars from the burning building, and the only feasible manner of accomplishing this appears to be a *safe* and *legitimate* grade.

The writer has lately had occasion to visit a car house which is being constructed on the latest fire proof ideas, such as, brick walls, iron roof, cement floors, pits, etc., yet with all these advantages it is presumably safe to say that not half the cars would be saved if a fire occurred in the building. There are to be five tracks in this building, no grade, with a transfer table connecting with the one track leading from the building.

Unfortunately the property is so situated that these arrangements can not be bettered, and of course with the above case a grade would be of little use, but where circumstances will permit of a grade being constructed, it certainly would be of advantage to both insurer and insured.

On account of the enormous amount of capital being invested in electric railroads, I am sure this point is worthy of the utmost consideration, and trust that it will be thoroughly ventilated, with good results, in your columns. The subject is one peculiarly to be helped by discussion, as it is a new question in a new field, with little to be learned from horse railway precedents.

THE LAIN NOVEL ELECTRIC RAILWAY TROLLEY APPLIANCES.

Messrs. J. H. Bunnell & Co., of this city, have just brought out a new line of trolley fixtures, the invention of Mr. David E. Lain, of Yonkers, N. Y., a number of which are novel in construction and a brief description of which will prove of interest.

Fig. 1 shows the Lain improved mechanical clamp for suspending the trolley wire. This clamp is made of malleable iron and consists of two essentially similar parts each having a groove near its lower edge for the trolley wire, and also provided with interlocking lugs the faces of which are inclined at a small angle with the grooves. These parts are so proportioned that when placed facing, but not registering with, each other on the wire, the lugs will interlock; and as the parts are driven nearer and nearer to opposition the inclined faces of the interlocking lugs clamp more and more firmly onto the wire. A powerful clamping force is thus obtained which occurs at points near the ends where it is most needed.

The strength of the material of which these clamps is made permits of their being ground down sufficiently thin along the lower edges to provide an uninterrupted path for the trolley wheel along the under side of the wire and yet firmly secure the wire. Another lug on one of the parts is tapped for the screw on the insulator bell and the screw enters sufficiently far below this lug to lock the other part in its place. These clamps are supplied tapped to fit any insulator.

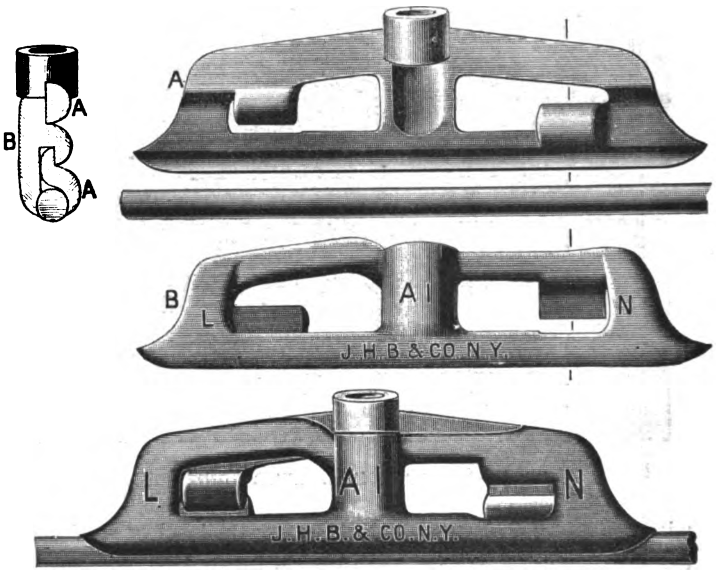


Fig. 1.—Lain's Improved Mechanical Clamp.

Fig. 2 shows Lain's improved non-sparking trolley frog. The novelty in this frog consists in the form of its approaches, the floors of which are extensions of the central floor of the frog inclined sufficiently upward so that one of the flanges of the trolley wheel is the first to strike the approach and is gradually depressed until it is below the wire when it may cross the central portion of the floor of the frog on its flanges. The sparking which often occurs between the wire and the wheel when the wheel groove enters on the inclined rib, as usually constructed, is thus avoided.

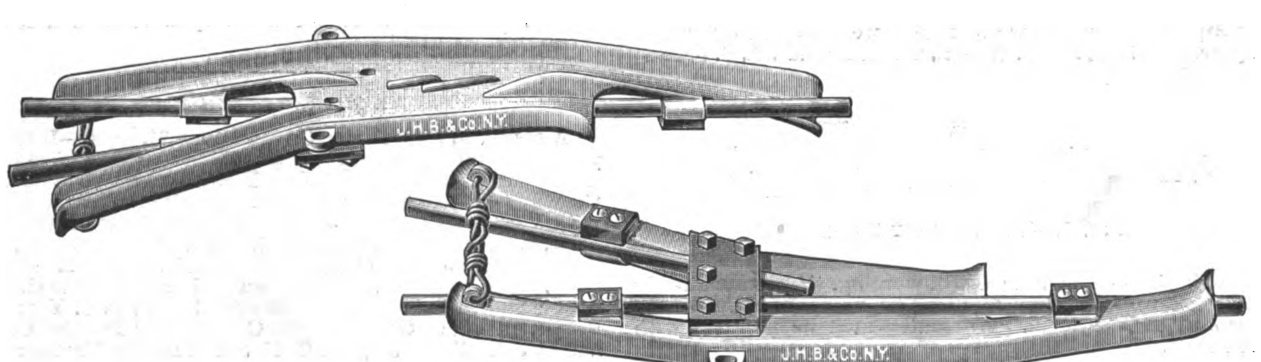


Fig. 2.—Lain's New Non-Sparking Trolley Frog.

Fig. 3 shows Lain's new adjustable crossing. It possesses all the notable non-sparking qualities of the Lain frog, and is very light, neat and simple.

Fig. 4 illustrates Lain's section insulator which combines the best features of the two most usual types. A strong piece of fibre is provided at each end with a brass casting suitably shaped for attachment to the end of the trolley wire. Each of these castings is provided with a strong screw clamp for connecting in the feeder wires. And the break between the castings and the fibre is rendered less sudden by four short blocks of brass separated by short spaces and insulated from each other. Several layers of mica are placed between these blocks and the fibre in order to protect it from the sparking incident to the interruption of the current. The spark is thus reduced in destructive effect and is borne

by the metal rather than by the fibre; and the long space of unbroken insulation in the middle of the device insures reliable insulation.

Fig. 5 shows Lain's screw clamp bridle and anchor ear. The trolley wire passes through a deep groove in a brass ear and is securely clamped in the bottom of the same by means of a screw clamp the cap of which has projecting arms that bend downward on either side as far as the horizontal plane of the wire. These arms afford places for attaching the guy wires at points in the horizontal plane of the trolley wire. Thus the strain on these wires does not deflect the trolley wire out of the horizontal plane. And, since the bridle is attached by screw clamps, it is quickly placed in position and as easily moved when so desired.

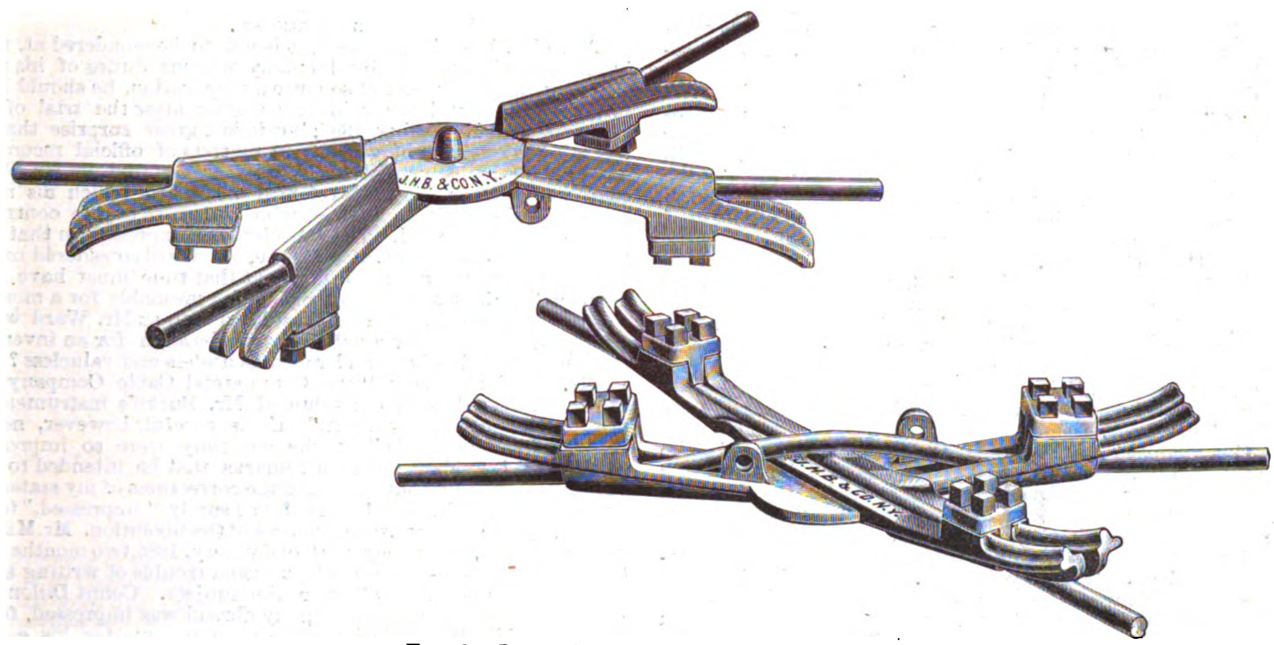


Fig. 3.—Lain's New Adjustable Crossing.

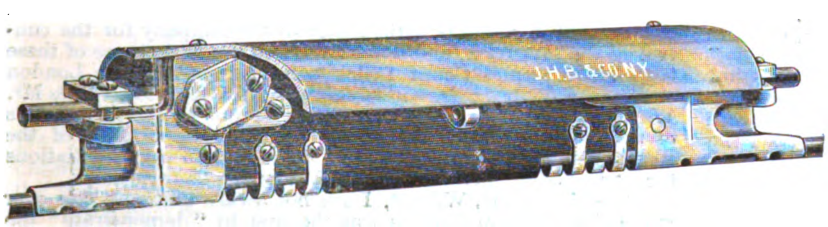


Fig. 4.—Lain's Section Insulator or Trolley Break.

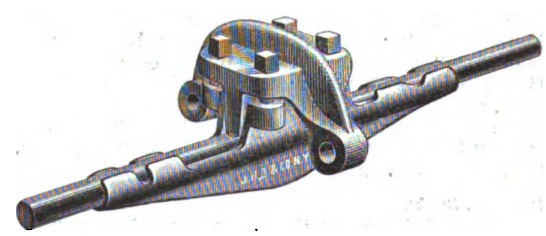


Fig. 5.—Lain's Perfected Bridle.

On some of these devices Mr. Lain has already obtained patents, and the novel features of the others are subjects of applications now in the Patent Office.

QUICK WORK AT MUNCIE, IND.

Last week, our Railway Department contained an interesting article on the electric road of the Citizens' Street Railway Company, of Muncie, Ind., operated with natural gas as fuel. We may now supplement it by a record of some very expeditious work, for the report of which we are indebted to Mr. W. C. Gotshall, the general manager and superintendent:

After a delay of 12 days on the "Big Four," the material for the building of one mile of track arrived on last Monday morning, June 19. This material had been lost on the "Big Four" for 12 days. It was necessary that this mile of track should be down and the road operating by one o'clock on the following day in order to carry a large mass of people to the opening ball game between the Muncie and Indianapolis Clubs held at the Base Ball Park recently erected by this company. At four o'clock Monday morning the work of unloading the rails and hauling them out to the line, somewhat over a mile from the depot was commenced. By five o'clock that morning the first bridge was crossed, 248 feet in length, and 1,000 feet of track had been laid. This bridge, by the way, is an iron truss bridge which we had built in three weeks. The work of laying the track was continued from four o'clock Monday morning until 12 o'clock the next day without any intermission whatever. In that time, just 32 hours, 4,800 feet of track had been laid; the rails hauled from the depot, spiked down, track lined up, surfaced, dirt thrown back in, and a car started over the road. The road was started at 12.30 and has been in operation ever since, not having been shut down a minute from any cause whatever.

The railway company carried 8,000 people over the road that afternoon. To the best of my knowledge this is the quickest piece of work on record, as I have been unable to find anything even approximating it. Not only was the track all laid as above stated, but the poles were erected and the trolley wires strung and the feeders tapped in. This completes the west side line of this company. That is, we have now started the third of our lines, this last line running from the Court House to the west side, a distance of about 3.20 miles. While in Chicago the other day, I purchased the wire, equipments, etc., for the south side line which will run into the southern part of the city, and be about five miles in length. Work upon this line will be begun at once.

MAGNETIC PROPERTIES OF LIQUEFIED GASES.

Liquid oxygen is an excellent insulator. A spark of 25 mm. in air will only discharge across 1 mm. of liquid oxygen. The spark from an induction coil shows the effect of this shortened distance better than the spark from a Wimshurst machine. The magnetic properties of oxygen gas were originally shown by Becquerel, who allowed charcoal to absorb it, and then placed the charcoal, with its charge of gas, in the magnetic field. Prof. Dewar has proved the magnetic properties of liquid oxygen by pouring some into a cup of rock salt and submitting it to a magnetizing field between, and a little below, the poles of an electromagnet. The liquid rises and connects the two poles, or the liquid may be drawn out of a tube by a magnet. Liquid oxygen seems to produce no disturbance in a Hughes induction balance. The magnetic moment of iron being taken as 1,000,000, that of liquid oxygen is about 1,000. Some cotton wool, when saturated with liquid oxygen, was strongly attracted by a magnet, the liquid being sucked out upon the poles. Prof. Dewar predicts that fluorine will also have to be classed as a magnetic gas. Liquid air is also highly insulating, and strongly magnetic.

LETTERS TO THE EDITOR.

AUTOMATIC WORK ON LONG SUBMARINE CABLES.

I AM pleased to note that my effort in the cause of historical exactness in the matter of automatic work on long submarine cables, which appeared in your journal under date of May 24, has called forth a contribution from Mr. Geo. G. Ward, vice-president and general manager of the Commercial Cable Company, which appears in your issue of June 21 and which is supplemented by statements from the company's superintendent at Waterville, Mr. Wilmot, and its electrician at New York, Mr. Cuttriss, and to perceive that the dates and material facts which I alleged in regard to my experiments over the cables of the company are not disputed by either of these gentlemen. It is therefore to be assumed that they were correct.

The deductions sought to be drawn from these conceded facts are, however, questioned and in a general way denied and contradicted, and several matters not germain to the subject seem to have been unnecessarily interjected into the discussion. With the view of clearing away all sophistical obscurity and for the purpose of enabling such of your readers as may be interested in this matter of arriving at the truth I will now more fully detail than in my former communication my past relations with the Commercial Cable Company.

On the 17th day of December, 1883, which was some time anterior to the organization of the Commercial Cable Company by Messrs. Mackay and Bennett, I had applied for patents on certain improvements in cable telegraphy, and these improvements soon thereafter, and before the Commercial Cable Company had existence, were embodied in working models and arrangements made for their trial over one of the Atlantic cables through some of my London friends.

The Commercial Cable Company commenced business in the latter part of 1884. At that time I was engaged in perfecting some improvements in printing telegraphs under the direction of Mr. Henry Cummins, then vice-president and general manager of the Postal Telegraph Company. Mr. Mackay about then became interested in the Postal Telegraph Company, his representative there being Mr. Henry Rosener. Through Mr. Rosener's relations to that company he became acquainted with my cable improvements and of my intended trip abroad to have them tested, and it was in compliance with Mr. Rosener's solicitations and expressed wishes that my automatic key-board transmitter was placed in the office of the Commercial Cable Company for the purpose of being tested on the New York and Canso cable.

With this explanation let us now consider what Mr. Cuttriss has to say about the trial of November 15, 1885. Mr. Cuttriss says that "it was the very opposite of a pronounced success." His memory evidently needs refreshing, or else his opinion, at that time, was at fault. The following verbatim copy of his letter to me enclosing portions of the record of that trial, and which were sent on from Canso, clearly indicates that he, then, regarded the trial successful. Here is his letter:

Dear Mr. Burke,

Enclosed find slips from Canso, they seem to be very successful.

Yours truly,

Novr. 23, 1885. (*Signed*) CHAS. CUTTRISS.

After receiving such a communication from so competent a critic, I think I was quite justified in believing the trial a "pronounced success." Mr. Cuttriss also now states that "the speed attained by his (my) instrument never even approached the speed obtained daily by ordinary hand sending." I fear his memory is again at fault, for whilst I have no means of knowing what speed the company was then getting "daily" over this cable by "hand sending" I have good reasons to believe that it could not have been very much in excess of that of my transmitter at that trial. The speed of the transmitter as then reported to me by Mr. Cuttriss, the time having been noted by both Mr. Cuttriss and Mr. Hoenack, was 27 words per minute counting five letters to a word. For a first trial of a necessarily still unperfected instrument, and in the absence of familarity with its operation, I hazard the statement that no such satisfactory a result was ever before obtained under simular conditions. Mr. Cuttriss' facetious reference to "elation" on my part, in the way he puts it, had only existence in his own vivid imagination. It may be different with Mr. Cuttriss, but I beg to assure him that slow signals over any cable under any circumstances have always an effect on me the very opposite of elation. Further on Mr. Cuttriss says that "he made a report at that time in which he distinctly pointed out the utter failure of the instrument to accomplish what is claimed for it." He may be able to explain the discrepancy between this report and his letter to me and to account for the disregard paid to his report by his superiors as evidenced by their subsequent desire to acquire control of the invention. When Mr. Cuttriss makes the statement "that the privilege of further trials on the company's cables was only granted after persistent endeavors on my part," he forgets that such a matter as that was not within his cognizance, nor is the statement correct. If there were any persistent efforts at all it must have been on the part of his superiors to control the invention, for as I have before stated, I had already, at that time, perfected arrangements for the trial of my invention over an older and then better known cable. I can well forego comment on Mr. Cuttriss' sneering remark that my invention "was not adopted by the Commercial Cable Company," in view of the fact that my contract with that company under which its adoption would have been effected was terminated at my own request. Before dismissing Mr. Cuttriss I emphatically disavow the intention which he imputes to me of "desiring of making capital, or gaining notoriety by using his name in connection with the experiments referred to," and I assure him, in all sincerity, that not until I saw it stated by himself was I at all aware that his name had acquired the wonderful potency which he imagines it possesses.

As to Mr. Ward's statement, it is not to be wondered at, that, burdened as he must be by the many onerous duties of his position as general manager of so large a corporation, he should have forgotten the part he took in this matter after the trial of my transmitter in November, 1885; but it is a great surprise that he has raised a question of veracity in matters of official record. I have before me a type written contract dictated by Mr. Ward some weeks after the trial referred to, and in which his name appears as the party in interest who desires to secure control of my invention so tested. The consideration expressed in that contract clearly proves that, at that date, Mr. Ward considered my invention valuable, and he certainly at that time must have been informed of the results of the trial. Is it reasonable for a moment to suppose that so shrewd and astute a man as Mr. Ward would seek to control and pay a valuable consideration for an invention that his electrician had condemned as useless and valueless?

Mr. Ward says that "the Commercial Cable Company was never impressed with the value of Mr. Burke's instrument or the results achieved with it." He is careful, however, not to deny that the "officials" of the company were so impressed, although it is evident from his remarks that he intended to convey the impression that he denied the correctness of my statement on that point. Mr. Ward himself was surely "impressed," for he sought, as I have shown, to get control of the invention. Mr. Mackay was impressed, for in the month of January, 1886, two months after this trial, he took—for him—the unusual trouble of writing a personal letter to Count Dillon on the subject. Count Dillon, the managing director of the company abroad was impressed, for on receipt of Mr. Mackay's letter he gave the matter his earnest personal attention for several days in Paris, and as then understood, after having received full accounts of the trial from the New York office; Mr. DeCastro was impressed, for after the matter had been turned over to him by Count Dillon he named the terms that would be satisfactory to the company for the control of the invention, and when I advised my acceptance of these terms, both he and Count Dillon came immediately to London and had a contract drawn which was duly executed. Does Mr. Ward desire any further "conclusive" proof that "the officials of the company were impressed with the importance of the results achieved," or further facts in regard to the negotiations for control of the invention? If so, they can be furnished.

Referring to Mr. Wilmot, I am not aware that any one ever made the assertion that he was the first to "demonstrate" the practicability of working long cables successfully by means of an automatic transmitter, nor would such a statement be true. Neither would it be any more correct to credit this to Messrs. Thomson and Jenkin, than it would be to attribute the discovery of the Hudson River to Christopher Columbus. The labors of these renowned scientists were on a much loftier plane, and allusion to them in connection with this discussion is entirely gratuitous. Mr. Wilmot states that the results of the experiments on the Waterville-Canso Cable "were not a success" and that he gave an "unfavorable report" of them, because, as he says, on the ground that the speed of transmission per minute was "less than one-half of what they were doing by hand signalling." How fair it was to make any such report can be judged when I state the fact that not one single test was made over that cable, which had for its purpose the ascertainment of the speed of general transmission. Of this fact Mr. Wilmot was well aware. The trial on the Waterville-Canso cable was for the sole purpose of determining the degree of legibility of signals transmitted in this way and of the availability of entirely new electrical combinations in the arrangement of my code. It had also as an object the finding out with greater certainty the possible speed that could be depended upon when all electrical and mechanical conditions were brought to their perfection. From this standpoint, these trials were a decided success, and it was clearly proven by an analysis of time occupied by the elements of the signals that with properly organized instruments of this kind, a speed more than twice that which the Company was then getting, was within easy accomplishment. This is not new to Mr. Wilmot, for we discussed the matter freely and fully at the time, and I explained to him in detail the improvements I intended making in my key-board transmitter on my return to the United States and which I was convinced was all that was required to make it perfect. That such an

explanation was given to Mr. Wilmot is evidenced by the following verbatim memorandum :

"On the 8th day of March, A. D. 1886, at Waterville, County Kerry, Ireland, the three sheets of writing marked 'Burke's Improved Transmitter,' and numbered respectively, 1, 2, 3, 4, 5, 6, were shown to me and the contents thereof read in my hearing and the nature of the invention therein set forth explained fully to me, and for the purpose of identification I have attached my signature to each of said sheets."

(*Signed*) THOMAS SLEATH,
Kenmare, County Kerry, Ireland.

To the above Mr. Wilmot appended the following :

The same writing has been read to me and the explanation given me on the same 8th day of March, 1886.

(*Signed*) T. J. WILMOT,
Waterville, County Kerry, Ireland.

As to the Wheatstone incident I have only this to say, that if Mr. Wilmot will consult his "Service" to Count Dillon, asking permission for me to have the experiment referred to tried, he will have a more correct recollection of the circumstances.

It is probably unfortunate that I was unknown to Mr. Wilmot before my arrival at Waterville, and it is doubtless only a coincidence that his instrument was not in successful operation until after a month from the time of the trial of my automatic keyboard transmitter and after I had given him full details of the improvements I proposed to make in it on my return to America.

I am familiar with the fact that Mr. Wilmot, by a species of intuition peculiar to himself, has the faculty of anticipating previous inventions, but remembering the arguments which he and the other electricians of his company then urged against the possibility of simulating the peculiar effects of hand sending by automatic means, and which they insisted was of absolute necessity in order to produce readable signals on a long cable, I am greatly surprised, now to learn, that, at that time, he was actually engaged in trying to accomplish the "impossible."

History to be valuable should be true, and only facts, not words, can make it so.

CHARLES G. BURKE.

BROOKLYN, June 24, 1893.

CALCULATING JOINT RESISTANCES.

Referring to the article in your issue of June 21, on "A Simple Method of Calculating Joint Resistances," by Mr. W. C. Ramsdell, I would state that I fail to see wherein lies the difference between this method and the one which the writer terms "Second, or Reciprocal Method." If we take the example cited, namely: Given conductors A, B, C, D, E, having resistances of two, three, four, five and six ohms respectively; to find the joint resistance, we would have according to the second method to add together,

$$\tfrac{1}{2}\,\tfrac{1}{3}\,\tfrac{1}{4}\,\tfrac{1}{5}\,\tfrac{1}{6} = \frac{60+40+30+24+20}{120} = \frac{174}{120}$$

for the conductivity of the circuit, and the reciprocal of this $\frac{120}{174} = \frac{20}{29}$ for its resistance. In what particular the new method differs from this, I fail to understand, for both consist in finding the least common multiple of the resistances, dividing this by each individual resistance, and adding together the quotients; the sum divided by the least common multiple of the resistances, being the reciprocal of the joint resistance.

All three of the methods are in fact the same. If we have two resistances, r_1 and r_2 in multiple, their joint resistance according to the conductivity method, would be $R = \cfrac{1}{\cfrac{1}{r_1} + \cfrac{1}{r_2}}$, and by simply multiplying out, we obtain $R = \frac{r_1\, r_2}{r_1 + r_2}$, which formula the writer calls the first method, and states that "when more than two circuits are to be considered, the joint resistance of any two of them must first be found, and that joint resistance considered as that of a single circuit, taken with another circuit, to find another joint resistance; and so on, until all the circuits have been used, the final quotient being the joint resistance sought." Were this true, it would, indeed, as the writer states, be an undesirable method; but obviously it is not. We may extend the above method to any number of resistances. Suppose there are four r_1, r_2, r_3, r_4, placed in parallel. Then from the conductivities, the joint resistance is $R = \cfrac{1}{\cfrac{1}{r_1} + \cfrac{1}{r_2} + \cfrac{1}{r_3} + \cfrac{1}{r_4}}$, and clearing of fractions as above, $R = \frac{r_1 \times r_2 \times r_3 \times r_4}{r_1 r_2 r_3 + r_2 r_3 r_4 + r_1 r_3 r_4 + r_1 r_2 r_4}$; and similarly, for any number n of resistances, placed in parallel, the joint resistance of the circuit is a fraction, whose numerator is the product of the n resistances, and the denominator the sum of n terms, each term being the product of $n-1$ resistances.

Perhaps it is easier to remember the rule which the writer calls the third method. It is certainly very simple, but for myself I have found it most convenient to remember only the two facts, that the conductivity in case of multiple circuits, is the sum of the conductivities of the component circuits, and that resistance is the reciprocal of conductivity. All formulæ for calculating joint resistances are obtained from these laws; they are in fact but different methods of expressing them.

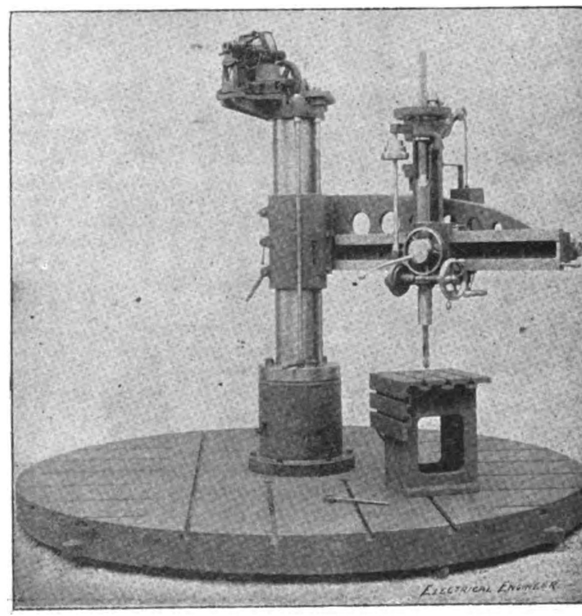
EDWIN R. KELLER.

Chicago, Ill.

BICKFORD RADIAL DRILL DIRECT DRIVEN BY CROCKER-WHEELER MOTOR.

To the interesting series of machine tools driven by electric motors with which the new Crocker-Wheeler factory at Ampere, N. J., is equipped we are able to add the combination shown in the accompanying engraving. This is a radial drill made by the Bickford Drill and Tool Co., of Cincinnati, O.

The motor used on the machine is distinguished by a very large armature and low speed which qualifies it in every respect as to the motive power for heavy drilling machinery. It is fastened to the top cap of the drill column, and its armature shaft is supplied on one end with a raw hide pinion which drives a short horizontal shaft on one end, having a large spur wheel, and on the other end a steel mitre wheel. The spur wheel matches into the raw hide pinion and the other into a mitre wheel on the top end of the splined vertical shaft at the back of the column. From this shaft the power is transmitted to the horizontal splined shaft at the back of the arm and from here to a short vertical shaft back of the head which drives the spindle direct. On this latter shaft the back gear is attached, which arrangement takes away all strain from the long splined shafts on radial drills while doing heavy work.



BICKFORD RADIAL DRILL DRIVEN BY CROCKER-WHEELER MOTOR.

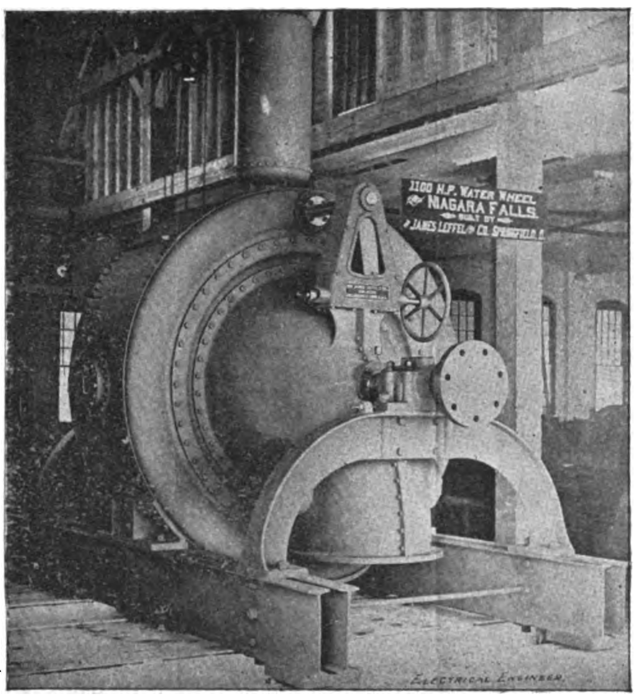
With the arrangement here adopted, the drill can be built in many parts lighter and neater, and the main point of advantage is a decided gain of power. The arm of the drill can easily be swung around in a full circle and the base is made also in a full circle shape, which gives the advantage of setting new work at the same time that the drill is doing its work automatically on another piece. The column of this drill consists of the inside column and the outside sleeve. The sleeve revolves easily on friction rollers and has bearings on top and on the bottom, thus avoiding binding and spring. The switchboard is put on any convenient part of the drill to be within easy reach of the operator. The elevating and lowering of the arm is done in the same manner as on the regular drills and offers no obstruction whatever to the motor. The test of this machine made at the shops of the Bickford Drill and Tool Co., was very satisfactory, and the drill did perfect work in every respect.

1,100-H. P. LEFFEL TURBINES FOR NIAGARA.

THE accompanying illustration represents a water-wheel recently built by Messrs. James Leffel & Co., of Springfield, Ohio, for the Cliff Paper Company, of Niagara Falls. The wheel is of the new type on horizontal shaft, and what is specially known as the new double discharge turbine, manufactured by the Leffel Company.

The water is conducted to the wheel from a canal near the top of the cliff, by means of an 8-foot pipe, made of steel plates, extending in nearly a perpendicular line to the mill, which is designed for two separate power plants, each driven by a wheel of the character here illustrated. The water enters the large flattened cylinder casing at the bottom, and circulates around the wheel and its guide casing, and is admitted to the wheel proper or runner, which is placed upon a horizontal shaft, the motion being vertical. The wheel, or runner, is in reality a double wheel, which splits the water, or divides it into equal quantities on receiving it from one set of gates.

After the water has operated upon the runner, it is discharged horizontally and in opposite directions, immediately passing in a downward direction through the curved elbows, to which are attached draft-tubes, on each side of the wheel casing. These tubes are extended down to a distance of some 18 to 20 feet from the centre of the wheel shaft, thereby operating to some extent,



1,100 H. P. LEFFEL TURBINES FOR NIAGARA FALLS.

through the atmospheric pressure, in connection with a hydraulic pressure above the wheel.

The runner is made of steel, iron and bronze; the segments carrying the buckets being bronze, and weighing a ton and three-quarters. The whole runner weighs nearly four tons. The runner is made of such diameter as to secure 280 revolutions per minute, under a practical working pressure of 130 feet, As the illustration shows, there are no gears or belts for communicating the power to the machinery, but at each side there will be connected two grinders, or four in all, requiring about 1,000 h. p. or 250 h. p. each, in addition to which there is considerable other machinery driven independently of the grinders.

The whole arrangement is of original design and is constructed in the strongest and most substantial manner, upon a guarantee as to durability and as to specific performance of work. The entire weight of each plant of wheels is 28 tons.

These are the only American design and pattern of wheels that have yet been put under the extreme height of head existing at Niagara Falls, and they are therefore the first turbines running under that pressure.

DECLARATION OF WESTINGHOUSE ELECTRIC DIVIDEND.

AT the directors' meeting of the Westinghouse Electric and Manufacturing Company in this city, on June 28, a cash dividend of 3¼ per cent. for the half year was declared on the preferred stock. The company is reported as doing a large and growing business.

EARNINGS OF THE GENERAL ELECTRIC CO.

THE directors of the General Electric Co. held a meeting on June 30 to consider payment of the quarterly dividend. It is said that the figures submitted by the management were as follows:

For the four months ending May 1, 1893, the net profits of the company were		$1,391,729.40
Net profit for June (partly estimated)		360.000.00
		$1,751,729.40
Less 5 months' accrued interest on debentures		208,333.30
		$1,543,396.10
Less 5 months' accrued dividends on preferred stock, 7 %	$124,013.75	
And 5 months' accrued dividends on common stock, 8 %	1,014,180.00	
		$1,138,193.75
Net surplus for five months over accrued interest and dividends		$405,202.35

The above profits are exclusive of all license and royalty stocks and other securities received since January 31st.

The operations of the two companies under the consolidated management commenced on June 1st, 1892. This is the first month, therefore, that an exact comparison of the operations of the General Electric Company with those of a previous year has been possible. For the first twenty-six days of June the output of the factories and the business of the company were about fifteen per cent. more than for the same period in 1892, with a corresponding increase in net profits. The usual quarterly dividend of 2 per cent. on common stock was voted by the directors.

THE M. A. GREEN IMPROVED TANDEM COMPOUND ENGINE.

THERE is a large demand in this country to-day for compound engines, of which there are two classes, known respectively as the cross and tandem compound. Thus far the cross compound has had the preference on account of the ease of access to both cylinders; but one of its drawbacks lies in the fact that the cross compound engine has two sets of reciprocating parts. The high pressure set can easily and successfully be arrested by compression, but on the low pressure side, if the reciprocating parts are not arrested by compression, the engine will be noisy. The only remedy left is to use compression on the low pressure cylinder as well as on the high to arrest the reciprocating parts on moderate speed engines, but this is done at a sacrifice of economy. On the tandem compound type, there being only one set of reciprocating parts, and these being arrested by the high pressure cylinder, the low pressure cylinder is comparatively free from compression, and allows of exhausting at about atmospheric pressure, which puts the economy on the side of the tandem compound type. It was with the object of retaining the good qualities of the tandem type and of eliminating the disadvantages above referred to that the M. A. Green improved tandem compound engine has been designed. The accompanying engravings, Figs. 1 and 2, show the new engine in perspective and in section, respectively, the engine being built both of the side and centre crank pattern.

It will be noticed at a glance at Fig. 2, that to remove the pistons of these engines all that is required is to take off the cylinder head of the low pressure cylinder and to unscrew the two nuts which hold the piston on the rod; these being jam nuts, one of fine thread and the other one of coarse, which prevents them from coming loose. After the piston has been removed by the use of a socket wrench, the nuts can be removed from the studs which hold the middle head in place, and then, by unscrewing the piston rod out of the cross-head, both the middle head and high pressure piston can be taken out through the low pressure cylinder. This can all be done without removing either cylinder or interfering with the valve motion. This valuable improvement on the tandem compound type places the Green engine side by side with the cross compound as far as convenience is concerned; and, it is claimed, far in advance of the cross compound when it comes to simplicity, smooth running, ease of handling and economy.

Another valuable feature in this tandem compound type, is that stuffing boxes between the two cylinders are done away with. The packing that is in the middle head is a newly designed double metallic packing which will last from four to five years and require no attention whatever. The stuffing box on the high pressure cylinder is also packed with a new and improved metallic packing which will last about the same length of time.

The remaining parts of this engine have all the well-known Green improvements used on the simple engine, relating to the construction of the governor, crank shaft, heavy wheels, cross-head, etc. These engines are specially adapted for electric railways, electric welding or lighting plants, or any place where heavy duty and close regulation are required; and are built by the Altoona Manufacturing Co., of Altoona, Pa.

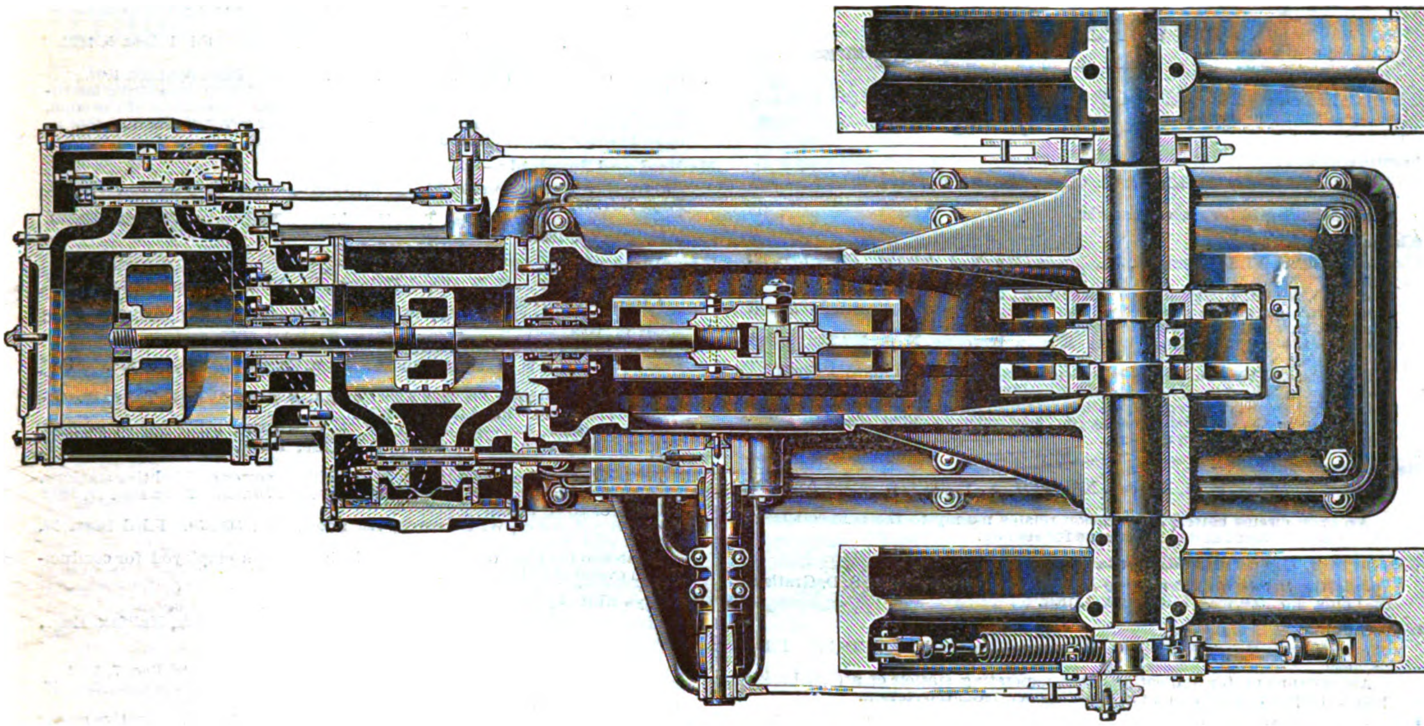


FIG. 2.—THE M. A. GREEN TANDEM COMPOUND ENGINE.

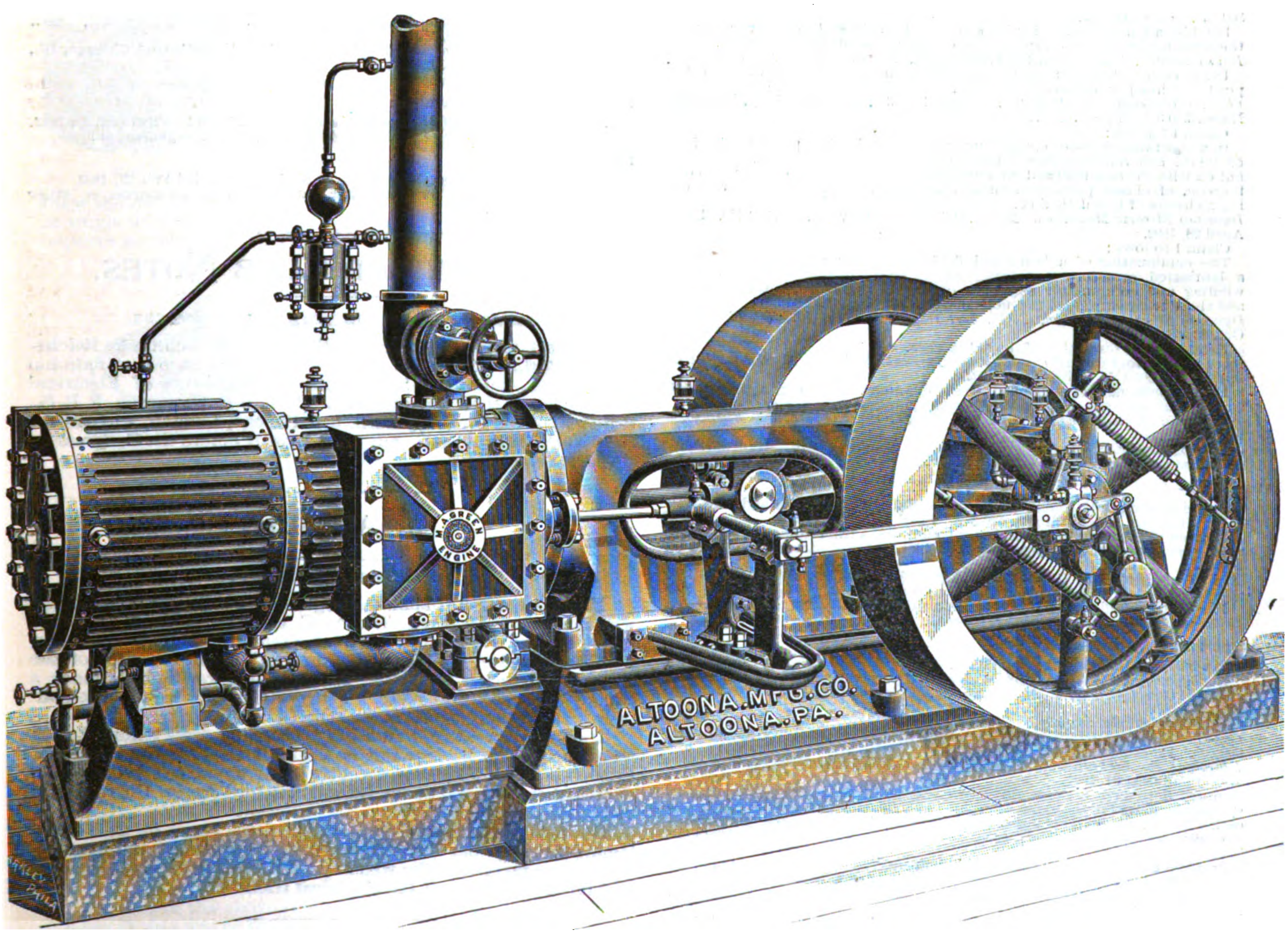


FIG. 1.—THE M. A. GREEN TANDEM COMPOUND ENGINE.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JUNE 27, 1893.

Accumulators :—

Secondary Battery, F. King & E. Clark, London, England, 500,394. Filed March 16, 1893.
A retaining grid for active material.

Alarms and Signals :—

Push Button, W. H. Berrigan, Jr., Jersey City, N. J., 500,110. Filed Dec. 19, 1892.
Electric Cut-Out, E. Egger, New York, N. Y., 500,229. Filed Nov. 8, 1892.
A thermo-expansive device for interrupting a circuit and giving a signal when the current becomes abnormally great. (See p. 4.)
Police Signaling Apparatus, W. H. Kirnan, Bayonne, N. J., 500,285. Filed Dec. 28, 1892.
For distinguishing audibly between emergency calls and report signals.
Indicator, A. Utzinger, Nuremburg, Germany, 500,359. Filed Feb. 9, 1893.
Designed to produce corresponding motion between like or similar parts of two mechanisms widely separated; applicable to ships, steering apparatus, dial telegraphs and the like.

Batteries, Primary :—

Galvanic Battery, M. M. Hayden, New York, N. Y., 500,284. Filed April 28, 1892.
An open circuit battery. Invention relates mainly to the connections of the carbon element and to the means for sealing.

Conductors, Conduits and Insulators :—

Insulating Device for Preventing Electric Currents in Pipes, S. D. Gratiaa, St. Louis, Mo., 500,488. Filed Sept. 1, 1892.

Distribution :—

Station Potential Indicator, C. F. Scott, Pittsburgh, Pa., 500,543. Filed 28, 1892.
An instrument for indicating, at a generating station of a distribution plant, the potential at a point at any distance from the station.

Dynamos and Motors :—

Electric Motor and Dynamo Electric Machine, R. M. Hunter, Philadelphia, Pa., 500,183. Filed Oct. 4. 1892.
Designed to operate at variable or slow speeds and to regulate over a wide variation of load.
Electric Motor, C. S. Jones, Chicago, Ill. (deceased), S. H. Jones, Executrix, 500,135. Filed April 7, 1890.
Includes a plurality of pole pieces in both the field and armature and with the same number in both arranged at equal angular distances in both.
Brush Holder, S. H. Libby, Lynn, Mass., 500,144. Filed Jan. 19, 1893.
Designed to hold the brush firmly against the commutator in the same position while portions are worn away.
Electric Generator and Motor, W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass., 500,301. Filed Jan. 9, 1893.
Claim 1 follows:
In a generator or motor comprising an armature having polar projections or teeth, and a field or part in which the magnetism is constant, the combination with the said field and in inductive relation to the energizing coils thereon, of closed paths or circuits of low resistance for opposing or checking a change of magnetic flux.
Dynamo Electric Machine or Motor, P. Lange, Pittsburgh, Pa., 500,400. Filed April 28, 1892.
Claim 1 follows:
The combination of a laminated field magnet, an armature shaft, and a laminated armature consisting of a core, having a Gramme ring winding and commutator segments connected therewith, said armature and shaft being embedded in a non-conducting material.
Dynamo Electric Machine, F. H. Loveridge, Chicago, Ill., 500,403. Filed Oct. 22, 1892.
Relates to the formation of the pole pieces.
Automatic Short Circuit for Constant Current Machines, A. Wurts, Pittsburgh, Pa., 500,455. Filed Oct. 4, 1892.
For the protection of constant current dynamos. Produces a permanent short-circuit between the tongues when the potential becomes excessive.
Automatic Circuit Breaker, A. Wurts, Pittsburgh, Pa., 500,456. Filed Oct. 26, 1892.
For automatically opening the circuits of a constant potential machine when the current becomes excessive.

Heating :—

Electric Heater, C. E. Roehl, Chicago, Ill., S. Z. Mitchell, Portland, Ore. and E. P. Wetmore, Helena, Mont., 500,272. Filed Dec. 23, 1892.
Employ alternating or pulsating currents and a transformer in which the secondary is a continuous pipe through which water or air may pass and be heated.
Electrical Heater, J. F. McElroy, Albany, N. Y., 500,288. Filed Oct. 1, 1892.
Electric Heater, E. P. Wetmore, Helena, Mont., 500,520. Filed Dec. 23, 1892.
For heating liquids or gases which flow through a spiral chamber heated by induction from alternating currents.

Lamps and Appurtenances :—

Push-Button, J. S. George, Jr., 500,199, Philadelphia, Pa. Filed Oct. 20, 1892.
For lighting and extinguishing a single lamp, or a series of lamps.
Push-Button Cut-Out, J. S. George, Jr., Philadelphia, Pa., 500,200. Filed Nov. 28, 1892.
For electric light circuits.
Cut-Out for Electric Lighting Systems, J. S. George, Jr., Philadelphia, Pa., 500,201. Filed Dec. 30, 1892.
Filament for Incandescent Electric Lamps, J. Criggal, Newark, N. J., 500,279. Filed Oct. 31, 1891.
Intended to give a more effective emission of light. Two independent spirals are wound in the same direction, and lie at equal distance between each other, and have their upper ends connected by a transverse portion.
Electric Arc Lamp, W. Mathiesen, Leipsic, Germany, 500,341. Filed Sept. 5, 1892.
Provides mechanism to compensate for the increased resistance and diminished effectiveness of the controlling magnet caused by heating.
Hanging Device for Electric Arc Lamps, C. A. Pfluger, Chicago, Ill., 500,421. Filed Oct. 14, 1892.
Electric Arc Lamp, C. A. Pfluger, Chicago, Ill., 500,422. Filed Oct. 31, 1892.
Relates especially to the construction and use of an insulated clutch.

Measurement :—

Static Voltmeter, A. E. Kennelly, Orange, N. J., 500,236. Filed Aug. 6, 1892.
Operates by the attractive force of electrostatic charges given to suitable parts of the instrument by connection with a circuit.
Galvanometer, A. H. Hoyt, Manchester, N. H., 500,264. Filed Sept. 5, 1892.
Especially adapted for alternating currents.
Resistance Box, E. Weston, Newark, N. J., 500,362. Filed Sept. 10, 1892.
Relates to resistance boxes of the type employed with measuring instruments, and especially to the position of the contact terminals of the coils, which are placed beneath the rubber platform or cover of the box, that is, upon its inner instead of its outside surface.

Medical and Surgical :—

Electro-therapeutic Device, W. E. Washburn, Cedar Rapids, Ia., 500,172. Filed Nov. 11, 1892.
Electric Medical Apparatus, T. C. Hodgkinson, Melbourne, Victoria, 500,539. Filed Dec. 24, 1891.

Miscellaneous :—

Lightning Arrester, M. M. Wood, Chicago, Ill., 500,178. Filed Sept. 22, 1892.
A fuse-block arrester.
Electric Lighting Device, W. H. Clewley, Providence, R. I., 500,193. Filed April 15, 1893.
For lighting cigars, lamps, etc.
Fusible Cut-Out, S. A. Young and A. Alden, Maryville, Mo., 500,248. Filed April 3, 1893.
Regulating Switch for Electric Elevators, A. B. See and W. L. Tyler, Brooklyn, N. Y., 500,274. Filed Nov. 12. 1892.
Electric Lighter, B. Tropp, New York, N. Y., 500,357. Filed August 30, 1892.
Electric Indicator, W. B. Luce, Brookline, Mass., 500,404. Filed Jan. 4, 1892.
For indicating the condition of a line circuit in power and lighting stations.
Double-Pole Switch, C. A. Pfluger, Chicago, Ill, 500,423. Filed Dec. 19, 1892.
Designed to be weatherproof.
Lightning Arrester, W. Wurdack, St. Louis, Mo., 500,454. Filed Sept. 12, 1892.
Relates to the class of arresters in which the arc is employed for conducting an overcharge to ground.

Railways and Appliances :—

System for Supplying Electricity to Railways, M. H. Smith, Halifax, Eng., 500,256. Filed Oct. 26, 1887.
An underground system including sectional contacts.
Trolley Support, W. Duncan, Alleghany, Pa., 500,263. Filed Dec. 7, 1892.
Electric Locomotive, F. M. Stevens, White River Junction, Vermont, 500,276. Filed Feb. 29, 1892.
Includes a boiler, engine and dynamo on board the locomotive or car together with a storage battery.
Conduit Railway Trolley, E. P. Warner, Chicago, Ill., 500,306. Filed July 30, 1892.
A double trolley for use with underground conductors, reversible as to direction, and with a support yielding to irregularities in the position of the conducting wire.
Automatic Disconnector for Trolley Wires, R. N. Noyes, Haverhill, Mass., 500,417. Filed Jan. 23, 1893.
Inclosed Conductor for Electric Railways, J. A. K. McGregor, Chicago, Ill., 500,506. Filed March 19, 1892.
A sectional contact system.

Telephones and Apparatus :—

Magnetic Telephone, C. S. Forbes, London, Eng., 500,481. Filed Oct. 27, 1892.
Combines a magneto telephone and a microphone in organization.

Telegraphs :—

Telegraphy, C. Cuttriss, New York, N. Y., 500,226. Filed Feb. 21, 1893.
Especially adapted for automatic transmission on submarine or other insulated cables.

SOCIETY AND CLUB NOTES.

PAPERS FOR THE ELECTRICAL CONGRESS.

DR. STEPHAN LINDECK, of the Physikalisch-Technische Reichsanstalt, Berlin, will write a paper for the Chicago International Electrical Congress on "Materials for Standards of Electrical Resistance and their Construction." Prof. S. P. Thompson, F. R. S., Principal of the Finsbury Technical College, London, will sail for New York, July 15, and will read a paper before the Congress on "Ocean Telephony."

MARRIED.

PERRINE—ROEBLING.

MISS MARGARET ROEBLING, daughter of Ferdinand W. Roebling, was married to Dr. Frederick A. C. Perrine on June 28, at her father's home, 222 West State street, Trenton, N. J. The ceremony was performed by the Rev. Dr. John Hall, pastor emeritus of the First Presbyterian Church. The wedding took place under a canopy of smilax and roses. Penrose Convery, son of ex-Congressman Convery of Ohio, was the best man.

The bride was attired in a gray traveling dress trimmed with white lace. The bridegroom is a son of Capt. James Perrine of Freehold, N. J. He has recently been appointed professor of electrical engineering at the Leland Stanford Junior University in California.

Dr. and Mrs. Perrine will make their home in California. Hundreds of guests from New York, New Jersey, and Pennsylvania were present at the wedding. Dr. Perrine received the congratulations of hosts of old electrical friends.

PROF. E. J. HOUSTON, president of the American Institute of Electrical Engineers, had the degree of Ph.D. conferred upon him by Princeton College, at the last Commencement.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

MESTON FAN MOTORS IN THE MOUQUIN RESTAURANT, NEW YORK.

ONE of the oldest and most celebrated of the "down-town" restaurants in New York is "Mouquin's", in Fulton street, running through the block to Ann. Its clientage includes professional and business men of standing in the neighborhood, as well as many French merchants, and the proportion of lawyers, artists, and newspaper men is very large, the attractions being an admirable cuisine, irreproachable wines, and moderate prices. There has long been one drawback, namely, the inadequacy of the ventilation due largely to the narrowness and depth of the building; and as smoking is freely indulged in, except in the part of the upstairs room reserved for ladies, the air, at this season, has been so oppressive that even the repute and attractions of the place were of little avail on hot summer days. Many years ago, Mr. Mouquin was one of the first to try the incandescent light, but it did not then please him. This year he has returned to it, however, and in introducing it has seized the opportunity to install a large number of Meston fan motors. The effect has been marvelous, and with the incandescent light and cool breezes the famous old restaurant not only is holding all its regular patrons gathered together during 25 years, but is attracting a great many new ones, delighted to enjoy the sociability and hospitality of the quaint, well-conducted resort. Great is the fan motor!

NEW FORMS OF HAMMOND CLEAT.

Fig. 1.

WE illustrate in the accompanying engraving, Fig. 2, a new form of the Hammond cleat for use where three wires are required. It is practically similar to the two-wire cleat put on the market a few weeks ago, which has already created a very favorable impression among the trade. It combines all the salient features of the cleat already described, and for simplicity, completeness and low cost is equal to anything in its line. These new cleats furnish the easiest and quickest method of wiring, are made of the finest grade of glazed porcelain and require short screws. We also show the new Hammond insulator, Fig. 1, for use with arc wires, or single wiring of any kind. It is also made in a single piece and requires no tie wire. The Hammond Cleat and Insulator Company, of Boston, are receiving large orders for these goods, but are able to meet the demand promptly, having laid in a large stock. They will be glad to send samples on application, and request should be made at once by those likely to need cleats for coming work.

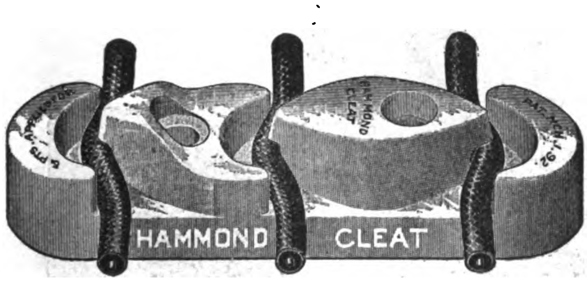


FIG. 2.

MATHER ELECTRIC COMPANY.

WE understand that business is very brisk with the New York branch of the Mather Electric Company, 95 Nassau street. They have recently added to their force the services of the following gentlemen: Mr. Henry M. Stiles, formerly with the Thomson-Houston Company, has accepted the position of Electrical Engineer. Mr. Harry W. Colby, formerly with the General Electric Company, of Boston, has accepted the position of General Agent for the sale of power apparatus and lighting plants. Mr. A. E. Bowers, has entered the service of Messrs. Claflin & Kimball, who are sole agents for the new "Novak" lamps, and can be found at the office of the above company. He will in future take entire charge of this line of the business.

They closed a contract last week with the Lynchburg Electric Company, of Lynchburg, Va., for one 100 h. p. generator, and also closed several contracts for small motors.

ACTIVE DEMAND FOR RODNEY HUNT TURBINES, ETC.

THE RODNEY HUNT MACHINE COMPANY, Orange, Mass., are having a large and increasing business in their turbine water wheels and other machinery. Their new machine shop addition greatly facilitates the handling of large contracts. At present among large orders they are making and setting wheels for the following parties:

Faulkner & Colony Manufacturing Company, Keene, N. H., one 42-inch and one 39-inch vertical wheel; Fall Mountain Paper Company, Bellows Falls, Vt., one pair of 36-inch wheels in iron case; Olcott Falls Company, Olcott, Vt., two pairs of 30-inch and one pair of 24-inch horizontal wheels in iron cases; Vermont Electric Company, Burlington, Vt., two 54-inch and two 27-inch horizontal wheels in stone flume; Swanton Electric Company, Swanton, Vt., one pair of 27-inch horizontal wheels in iron cases; Wyman Flint & Sons, Bellows Falls, Vt., one pair of 27-inch horizontal wheels in iron cases; Concord Land & Water Power Company, Concord, N. H., four pairs of 39-inch horizontal wheels in iron cases; E. B. Eddy Co., Ottawa, Canada, one pair of 48-inch horizontal wheels in wood flume; Burgess Sulphite Fibre Company, Berlin Falls, N. H., one pair 51-inch and one pair 42-inch horizontal wheels in wood flume; Exeter Manufacturing Company, Exeter, N. H., two pairs of 39-inch horizontal wheels in iron cases; Rock Manufacturing Company, Rockville, Conn., one 21-inch horizontal wheel in iron case; Tileston & Hollingsworth, Mattapan, Mass., one 30-inch vertical wheel in iron case; Yarmouth Manufacturing Company, Yarmouth, Me., one 39-inch vertical wheel in wood flume; Williamstown Manufacturing Company, Williamstown, Mass., one 60-inch wheel, vertical, wood flume; Consolidated Light & Power Company, Berwick, Me., two pairs of 33-inch horizontal wheels in iron cases; Manufacturing Investment Company, Madison, Me., one pair 42-inch horizontal wheels in wood flume; Public Works Company, Bangor, Me., one 66-inch vertical wheel in wood flume; High Falls Sulphite Pulp & Mining Company, Canton, N. Y., one 24-inch, one 12-inch and one 9-inch horizontal wheel in iron cases; Bay View Electric Company, Bay View, Baltimore, Md., one 24-inch vertical wheel in iron case; Glen Manufacturing Company, Berlin Falls, N. H., one 66-inch horizontal wheel in wood flume; Neshobe Electric Company, Brandon, Vt., one 18-inch horizontal wheel in iron case; Brattleboro Electric Company, Brattleboro, Vt., one 21-inch horizontal wheel in iron case; Orange Water Works, Orange, Mass., one 12-inch horizontal wheel in iron case; American Twine Company, Canton, Mass., one pair of 18-inch horizontal wheels in iron cases; H. D. Kendall, Enosburgh Falls, Vt., one 33-inch vertical wheel in wood flume; Fiske Paper Company, Hinsdale, N. H., one 36-inch and one 30-inch vertical wheel in wood flumes; Central Mills, Southbridge, Mass., one pair of 30-inch horizontal wheels in iron flumes; General Electric Company, Peterboro, Ont., one 33-inch vertical wheel.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY TO CHANGE ITS NAME AND LOCATION.

THIS company will, by July 1, have removed its entire stock and business from St. Paul to Minneapolis, and will be located in commodious quarters at 249 Second avenue South. The name of the company will be shortened for convenience and called Electrical Engineering Company. The new quarters being much larger than at present they will have every facility for handling supplies with great promptness; and they will also furnish factory facilities for the Northwestern Packard Lamp Company whose entire output (a capacity for at least 1,000 lamps per day) will be handled exclusively by the Electrical Engineering Company.

WESTERN NOTES.

THE ANSONIA ELECTRIC COMPANY have just issued a very neat and handy edition of their house goods catalogue which will be known as No. 44 B. They do not claim to have exerted themselves very much in getting out this catalogue, as its mission is only temporary, but at the same time, it contains quite a few new goods and some changes in prices, which make the catalogue quite valuable. They are at work on a large and complete edition which will not be issued for several months. Anyone wishing a copy of their Catalogue No. 44 B should write for it at once.

PITTSBURGH NOTES.

SCHENLEY PARK.—Mr. Chas. Ludlow Livingston, electrical contractor, Fidelity Building, Pittsburgh, Pa., has been awarded the contract for the wiring of the new Carnegie Library which is being erected in Schenley Park in this city, and which is to have 8,000 lights. It is to be equipped with brass-covered interior conduit throughout. Mr. Livingston also has the contract for the new Allegheny County Poor Farm Buildings, which are to have 2,000 lights, and brass-covered interior conduit throughout.

SOME SPECIAL APPLICATIONS OF THE MESTON ALTERNATING MOTORS.

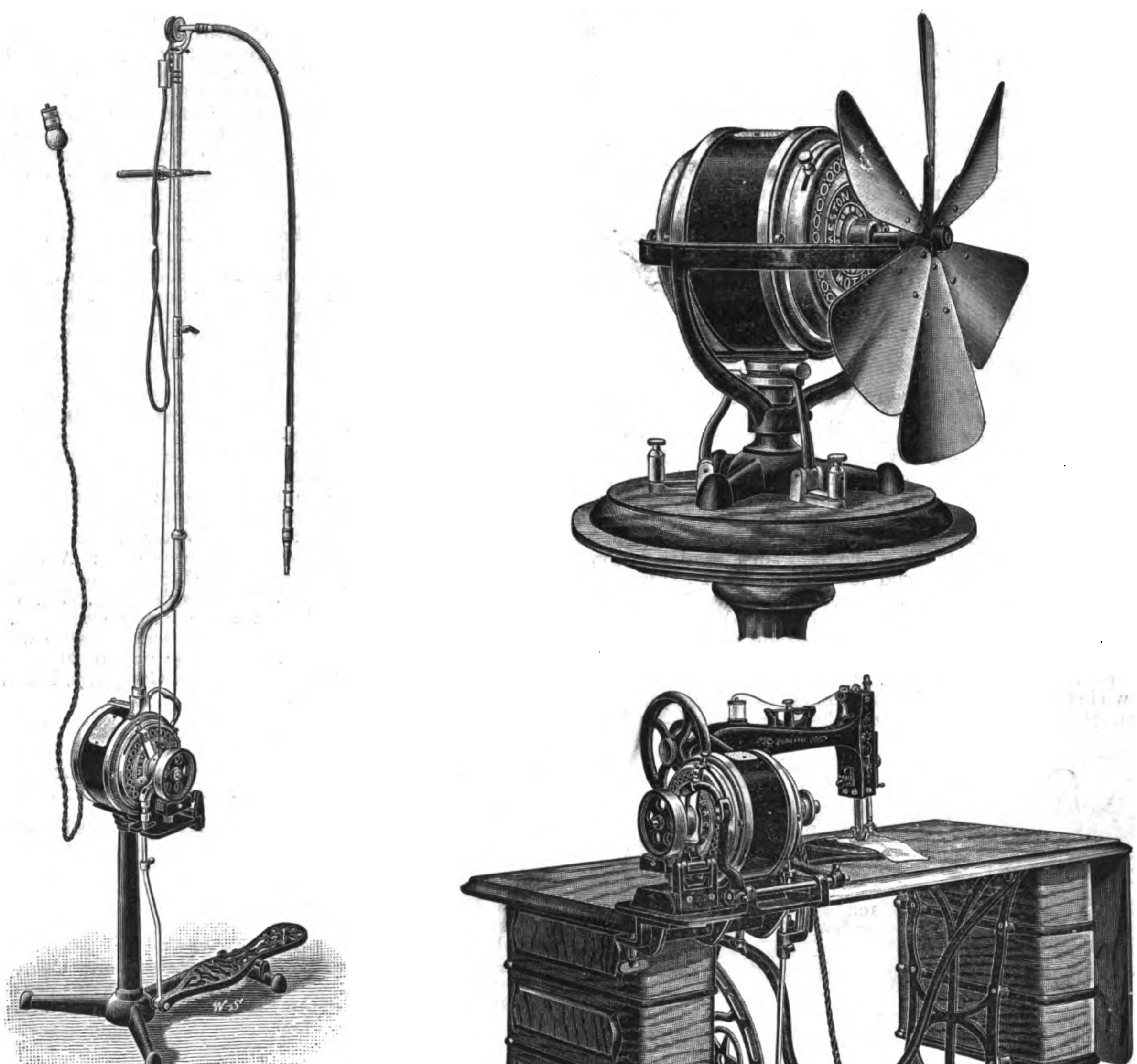
Having established the reputation of their Meston alternating current motor as a breeze producer, the Emerson Electric Manufacturing Company have been "looking for new worlds to conquer," and have branched out in the direction of applying their motor to other purposes. How well they have succeeded may be judged from the combinations here described and sold in the West by the Electric Appliance Company of Chicago, their general Western agents.

The first of these, Fig. 1, the Meston dental outfit is the result of several years' experimenting and experience with dental motors. The whole outfit weighs complete about 30 lbs. The motor gives a speed variable at will by a slight pressure on the foot lever from 150 to 2,500 turns per minute and can be instantly stopped or reversed. The stop brake acts mechanically, and when applied automatically cuts off the supply of electricity, avoiding any waste of current and danger of burning field coils. The standard may be adjusted to any desired height.

A practical sewing machine motor for use on alternating currents has been a device long sought after, and to the Emerson Company belongs the credit of producing the first satisfactory outfit. The cut, Fig. 2, shows the arrangement so clearly that very little explanation is necessary. The motor is arranged on a special base by means of which it can be readily clamped to any machine. It is regulated, started or stopped by a slight pressure on the treadle of the machine and can be run at any desired speed from 30 to 1,500 stitches per minute or over, or can be stopped instantly as the motor is provided with an automatic brake. In towns and cities where no day circuit is operated they can be used to good advantage for evening work.

It might not be out of place here to mention the latest thing in Meston fan motors, that is, their revolving fan motor, Fig. 3. By an ingenious mechanical device attached to the regular motor it is made to revolve 20 or 25 times a minute throwing a mild breeze 10 or 15 feet on every side. It is particularly adapted for offices and small stores and when mounted on a pedestal makes a neat and attractive ornament, giving a regular and gentle ventilation throughout the room, making a very desirable variation from the regular fan motor.

The Meston single and duplex power outfits, the first consisting of a single motor geared to low speed for power purposes, and the second, of two of the same motors coupled in the same way, have already been described in these columns and are meeting with an extensive sale.



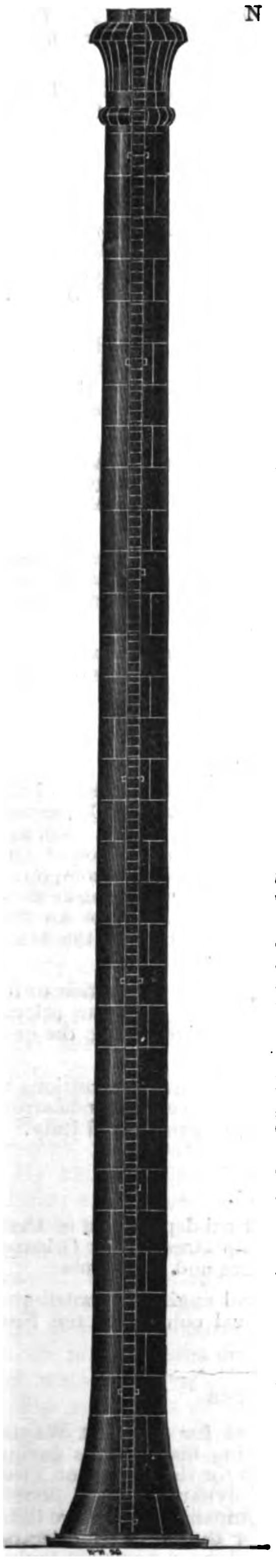
Figs. 1, 2 and 3.—Dental Drill, Meston Sewing Machine Motor, and Fan Motor.

The Electric Appliance Company, of Chicago, are general Western agents for all of the Meston outfits and carry a large stock.

REPORTING VESSELS AT SEA THROUGH THE ATLANTIC CABLE.

Captain Trott, of the cable steamer "Minia," while at sea in latitude 47.30 north longitude 32.30 west reported through the end of an Atlantic cable which he had on board for repairs the following steamers bound westward, viz., "Manhattan" and a Red Star steamer; also the "Paris" of the American Line and "Mohawk" of the Atlantic Transport Co. Line in the same position. Capt. Trott has reported steamers in mid-ocean on several previous occasions and was the first to introduce this novel method of making known the whereabouts of steamships, which is always greatly appreciated by those immediately interested in them.

IRON AND STEEL PLATE CHIMNEYS FOR ELECTRICAL PLANTS.



IN spite of the increasing use of iron and steel-plate chimneys the impression still seems to linger in the minds of not a few, that these structures are mere shells, requiring guys to keep them in position, and that they are not to be thought of in connection with a first-class plant. This idea, however, is entirely erroneous as demonstrated by the success met with by the Philadelphia Engineering Works, Limited, of Philadelphia, who have for many years constructed iron and steel-plate chimneys with great success, among these being many connected with the largest steel plants in the country.

These shafts rising to heights of 200 or 300 feet, are not only excellent protection against lightning, but serve also as an excellent advertisement, a point not to be overlooked in business operations in these days. The long experience of the above-named company has conclusively demonstrated the stability of these structures, none of which has ever failed in any particular, and, contrary to what is generally supposed, constant painting has not been required; in fact they have probably not averaged one coating in five years.

These chimneys are built very strong and are designed to withstand a wind pressure of 50 pounds per square inch, a pressure in excess of any ever recorded in this country. As to their draft efficiency it is interesting to recall a series of recent debates before the American Society of Mechanical Engineers, in which many members expressed themselves as convinced that an iron casing is superior to a brick one, in that it does not leak and draw in cold air, thus checking its draft.

As an example of recent chimney construction of this type we present an engraving of a chimney now being constructed by the Philadelphia Engineering Works for the Poughkeepsie Iron Company, Poughkeepsie, N. Y., to be placed close to the banks of the Hudson River. This shaft is 7 feet in the clear diameter of the iron work, and 125 feet high above the foundation. This stack is of moderate size and more likely to be called for than larger ones. The same rules, however, which are employed in calculating the stability of this stack, and its capacity in its application to boilers, etc., would be used in smaller and larger stacks. It has been asserted that this stack can only be thrown down by upsetting its foundation, and yet it will be observed that the foundation is spread to a very considerable extent, which spreading is provided to give a long leverage of resistance, and therefore requiring much less weight in the superstructure.

This stack is built strong enough to withstand 10 times the heaviest stress which will ever be put upon it in practice. This has been done to remove all possible question as to strength, and also as an unanswerable reply to the objection that these stacks weaken in time by rusting away. It is calculated and claimed that this chimney may rust away to one-quarter of its original thickness, and still exceed in strength and stability any brick structure ever reared.

WESTERN NOTES.

GREGORY'S DIRECTORY.—We are in receipt of a copy of this little directory and memorandum book giving a list of electrical and kindred interests. While there are errors in location, etc., it must be admitted that it is more correct than is usual in attempts of this kind. It is got up in convenient vest-pocket size, bound in leather. and will no doubt be of interest to a great many in the business.

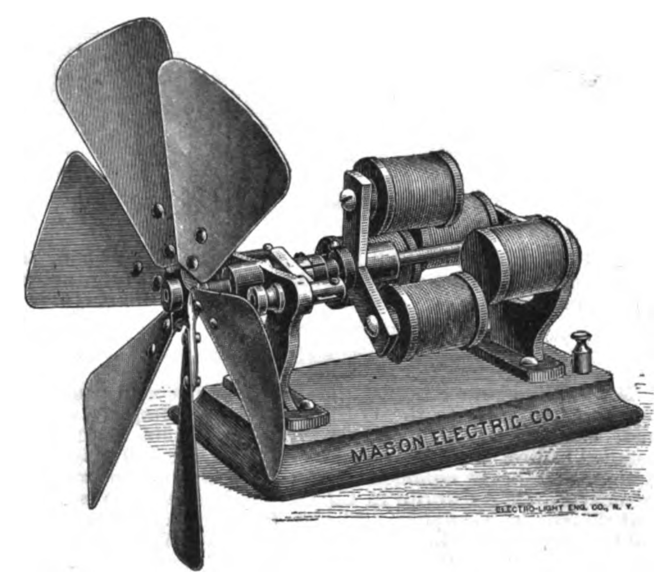
HARRISBURG "IDEAL" ENGINES.

W. R. FLEMING & Co. of New York and Boston, report that they have closed during the past month the following contracts: Two 100 h. p. Ideal engines for electric light service in the Municipal Buildings at Ward's Island; two 60 h. p. and one 15 h. p. Ideal engine for the *Mail and Express* building, New York (third order); one 125 h. p. tandem compound Ideal engine for direct connection to dynamos for the Bridgeport Copper Co., Bridgeport, Conn. one 50 h. p. Ideal engine and complete steam plant for electric light service for the Martha's Vineyard Company, Martha's Vineyard, Mass.

This firm is now erecting the following engines, some of which have been completed and started during the past week: Two 500 h. p. tandem compound Ideal railway engines for the Montreal Street Railway Co., Montreal, Can.; two 500 h. p. tandem compound Ideal railway engines for the New Britain Street Railway Co., New Britain, Conn.; one 500 h. p. tandem compound Ideal engine for the Taunton Electric Light Co., Taunton, Mass.; two 75 h. p. Ideal engines for the Fiftieth street station, and two 125 h. p. Ide engines for the Houston street station of the Broadway and Seventh Avenue Cable Railroad Co., New York City; two 60 h. p. Ideal engines for the Stewart building, New York City; two 50 h. p. Ideal engines for the Beresford, New York City; two 200 h. p. Ideal engines for the Central Park apartments, New York City.

THE MASON BATTERY FAN MOTOR.

AMONG the novel apparatus now being placed upon the market is a new No. 1 Motor, designed by Mr. J. H. Mason, and intended to be run by primary battery. The motor, which is illustrated in



THE MASON BATTERY FAN MOTOR.

the accompanying engraving is exceedingly simple in construction, and hence cannot get out of order. It is designed especially to work at high speed taking two amperes at five volts from three cells of the Mason battery, and this current runs it at 3,500 revolutions per minute.

In order to avoid the working loose of the binding posts, owing to vibration, a special device has been introduced by which this difficulty is entirely overcome. It is calculated that the cost of running this fan motor with the Mason battery does not exceed 14 cents for at 25 hours run.

These motors are manufactured by the Mason Electric Company, Nos. 10 and 12 Vandewater street, of this city, who also manufacture the Mason Motor No. 2 intended for running sewing machines and other light machinery. The Mason battery is also manufactured in various sizes by this company.

PASS & SEYMOUR.

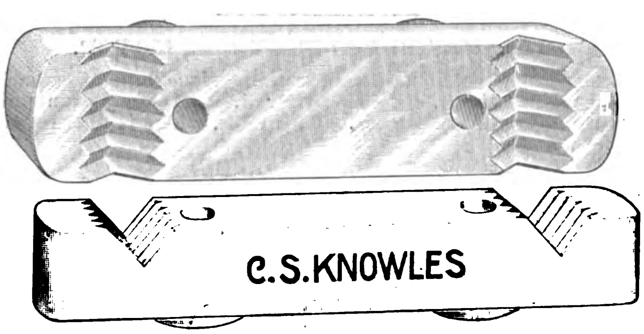
CATALOGUE No. 4 of electrical specialties, just issued by this celebrated firm of porcelain and china manufacturers of Syracuse, N. Y., is a very interesting publication for all connected with the electrical industry. It illustrates and describes a large number of novel and meritorious insulators of all kinds, and shows how valuable the "Syracuse china" is as an insulation for high potential currents and in all weathers and exposures. It is encouraging to see such marked advances made in the art and to know that there is sufficient encouragement to stimulate the production of goods of this high grade.

A PLANT FOR THE NORTH POLE.

THOS. H. DALLETT & Co., of Philadelphia, have just finished a most interesting plant for the Peary Expedition to the North Pole. It is intended to light Lieut. Peary's winter quarters, and as it has to be conveyed 700 miles on dog sleds, it has to be very efficient for its weight and to be built with a special view to portability and ease of packing. The plant includes a complete equipment, of which the main features are a 15 ampere dynamo, for 30 lights, a 2½ h. p. Case engine, and lamps and supplies for two years. Dallett & Co. will certainly have the proud distinction of sending an electrical plant furthest north, and not very far from the Pole. It will be curious to learn what special effect the location has on the plant and its efficiency.

THE NEW "DUGGAN" CLEAT.

THE accompanying cut represents the new porcelain cleat which C. S. Knowles, of Boston, is introducing to the electrical trade. As will be seen it is in two halves, both of which are interchangeable, being exactly alike, and either half of which can be used at will as the bottom or the top. The advantage is apparent, as, so long as there is more than one piece left in the barrel there is a complete cleat, avoiding all the annoyance of matching up two separate parts, which has been a great source of trouble in



THE NEW "DUGGAN" CLEAT.

the past. The cleat is well made of the best porcelain, is a thoroughly durable article, and will save wiremen a large amount of time and trouble.

NEW ENGLAND NOTES.

MR. J. BRADFORD SARGENT, of Boston, has recently sold a 250 h. p. Stirling boiler to the Portland Railroad Company, of Portland, Me. The boilers of this type, which Mr. Sargent has installed in New England, are all giving wonderfully high satisfaction, and he is confident that the Stirling boiler will soon become as great a favorite in the East as it is in the West. Last year the Stirling Company sold over 58,000 h. p. of these boilers, and they have yet to hear from one which has failed to give entire satisfaction. Being the manufacture of a Western company it is natural that this boiler should be better known in the West than in the East, but its record is so good that manufacturers in the East are now beginning to inquire about it of their own accord, and many are adopting it. It has, it is claimed, many valuable features possessed by no other water tube boiler, and can be sold cheaper than any other, besides being perfectly safe, and absolutely reliable. It is well worth the serious consideration of all central station managers, who are thinking of building new plants, or increasing their present ones.

THE EASTERN ELECTRIC CABLE COMPANY, of Boston, are again making a large addition to their factory, the constant demand for their wires and cables having necessitated such a step. For the past year Mr. Clark has been forced to run his present factory every night till 9 and 10 o'clock, even with such increased space as has been obtained during the past year. Now he is going to make a strong effort to have sufficient space to be able to turn out his orders in an ordinary day; hence the new addition. Clark wires and cables have obtained a firm hold on the public affection. Orders come steadily in, and must be taken care of promptly, as it is a well-known fact that wire is never ordered till it is required for immediate use.

THE WASHBURN SHOPS, a department of the Technology Institute, Worcester, Mass., have ordered a triplex Goulds electric pump to be operated by a Perret electric motor. The pump will supply sufficient water to operate two hydraulic elevators having pistons 5½ inches in diameter by 75 feet run. The elevators will be operated by the pressure tank system at about 140 pounds pressure per square inch and will run at a speed of 400 feet per minute. The apparatus is now being erected in the office building of Meekins, Packard & Company, Springfield, Mass.

THE ELECTRIC HEAT ALARM COMPANY, of Boston, have just issued a new catalogue describing their automatic fire alarm system for hotels, which calls attention in the office to the room in which the fire may be located. The company have lately been equipping several buildings at Haverhill and elsewhere. They have an exhibit at the Fair which is bringing them many inquiries.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., are putting up a new foundry for the Watts-Campbell Company, at Newark, N. J.

NEW YORK NOTES.

THE NEW JERSEY LAMP & BRONZE WORKS, New Brunswick, N. J., have ready for distribution to the electrical trade, a new catalogue of electric and combination fixtures which are novelties in design and finish. Several patterns are classified as ELECTRICAL ENGINEER style.

WM. C. CALLMANN & Co., who have recently opened offices at 136 Liberty street, have secured the agency for several fast selling electrical specialties, and report a good business from the start. Mr. Stahl, a member of the company, will represent them through the state.

MR. D. S. HOLCOMB, 48 Dey street, is making a specialty of contracting for all classes of electrical machinery and of repairs. He also does wiring for bells, lights, motors, fans, elevators, etc. He deals likewise in second-hand dynamos and motors.

MR. W. FORMAN COLLINS, business manager of the *Western Electrician*, has been in New York and Philadelphia the past week, and is devoting his time to calling on the many Eastern friends and supporters of that excellent journal.

MR. W. M. SCHLESINGER, the electrical engineer and expert, has just returned to New York, after a long professional trip abroad. He will probably remain here for a while.

WESTERN NOTES.

A. M. MORSE & Co., contracting engineers, St. Louis, and the Southwestern representatives of the Buckeye Engine Co., report several important recent contracts for Buckeye engines. Among them is a 500 h. p. plant for the electric lighting station of the new St. Louis Union Depot, consisting of three tandem compound non-condensing engines, direct coupled to Siemens & Halske slow speed multipolar generators. Another large order is for an 800 h. p. plant consisting of four medium speed engines for the Alton Electric Street Railway, Alton, Ill.

THE ANSONIA ELECTRIC COMPANY, are now in position to fill any orders with the new Sunbeam lamp, at very low prices. Judging from the number of orders they are receiving, the new lamp is even better than the old Sunbeam.

ITALY.—Some engineers from Italy have made propositions to the Ansonia Electric Company, to introduce the Wirt indicators, Wirt electricity meters and Wirt brushes, in France and Italy.

SOUTHERN NOTES.

LAMBERT BROS. have opened an electrical department of their gas and plumbing business, at 151 Camp street, New Orleans. They will be glad to receive correspondence and catalogues.

MR. W. T. M. MOTTRAM, the electrical engineer, contributes a very interesting and readable electrical column to the New Orleans *Times-Democrat*.

PHILADELPHIA NOTES.

MR. G. A. WILBUR, Philadelphia agent for the Fort Wayne Electric Company, has made the following installations during June:—Three 80 arc light Wood dynamos for the Powellton Electric Company; one 80 arc light Wood dynamo and 80 double lamps for the Diamond Electric Light Company; one 80 arc light Wood dynamo and 80 double lamps for the Suburban Electric Light Company; three 80 arc light Wood dynamos and 100 double lamps for the Manufacturers Electric Light Company; one 40 arc light Wood dynamo for the Waynesboro (Pa.) Electric Light and Power Company; one 80 arc light Wood dynamo for the Suburban Electric Light Company, of Scranton, Pa.; and two 60 arc light Wood dynamos at the Baltimore Yards of the Pennsylvania Railroad Company.

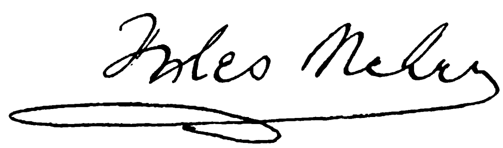
☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVI. JULY 12, 1893. No. 271.

A NEW METHOD OF ELECTRICAL HEATING.

BY



IN the issue of THE ELECTRICAL ENGINEER of June 14, an interesting account of a new process for electric heating and welding was given. The experiment is based on the quality possessed by an iron cathode of heating up very rapidly in a cell, whose electrolyte is acidulated water and whose anode consists of a leaden cylinder with a current of about 200 amperes at 120 volts passing through. I have experimented on the same subject in the laboratories of the Westinghouse Electric and Manufacturing Company, and would like to add a few words to the article above referred to, as my experiments lead me toward a somewhat different explanation of the heating effect.

In that article the resistance of the coating of hydrogen generated around the iron is alone said to produce the speedy heating of the iron cathode. In one of my experiments I sent 300 amperes at 125 volts through such a cell without obtaining any considerable heating of the iron, the total energy being consumed by the electrolysis of the water and the heating of the electrolyte. This was the case when the iron cathode was immersed *before* the current switch was closed, so that the hydrogen coating was present, but practically effected no heating.

By closing the switch *before* immersing the iron the whole experiment is changed. The moment the iron touches the water surface, the amount of hydrogen generated separates the liquid from the metal and an arc is drawn. The luminous effect of this arc drawn under water is most brilliant and especially striking when insulated wire is used instead of the bare iron rod, thus producing an arc in one point only, and wholly under the surface of the water.

The apparatus used had about the following dimensions: A plain glass jar eight inches high and five inches in diameter was filled with water containing 25 per cent. of sulphuric acid. The positive pole consisted of a $\frac{1}{8}$-inch sheet lead cylinder, the edges standing apart about two inches, so as to allow the inside of the cell to be seen. The iron cathode consisted of a $\frac{3}{8}$-inch round iron bar connected to the dynamo cable and fastened to a wooden stick. Several tests gave results as follows : With 20 amperes at 150 volts a weight of 15 grammes of wrought iron was brought to melting heat in 15 seconds, the iron actually dropping down to the bottom of the jar (which was covered by a disc of lead so as to protect the glass from the hot iron).

The approximate efficiency can be calculated as follows: An amount of heat H (1) is consumed in the iron; an amount of heat H (2) is consumed in the water and an amount H (3) is lost by radiation and conduction; a certain amount of energy E, is further consumed in the electrolysis of the water. In 15 seconds the temperature of 15 grammes of iron was raised about 2,000 deg. C., and 1,500 grammes of water 3 degs. C. This gives

$$H(1) = \frac{2{,}000\ (\text{deg.}) \times 15\ (\text{gr.}) \times 0.1138}{15\ (\text{seconds}).} =$$

250 gramme-calories = ... 1,048 watts;
0.1138 being the specific heat of the iron.

$$H(2) = \frac{3\ (\text{deg.}) \times 1{,}500\ (\text{gr.}) \times 1}{15\ (\text{seconds})} =$$

300 gr. cal. = ... 1,257 watts.
E (consumed in electrolysis) = 20 (amp.) ×
1.5 (volts) = ... 30 watts.
Total = ... 2,335 watts;

assuming 1.5 volts to be the counter E. M. F of the cell.

The total available energy being 20 (amps.) × 150 (volts) = 3,000 watts, we still have 665 watts, equal to 159 gr. cal., to dispose of for H (3), which is about equal to 29 per cent. of H (1) plus H (2), the total heat utilized.

The efficiency is thus found to be approximately 35 *per cent.* as 1,048 of the 3,000 watts are utilized in heating the iron. These calculations cannot certainly be considered exact, but are about as near as possible in this case.

Other metals, as copper and lead, are heated and melted quicker or slower according to their conductivity for heat. Carbon is heated in a very short time, but the melting off of amorphous carbon as reported could not be obtained and the authenticity of this phenomenon is seriously doubted by the writer.

The heating by the arc under water is evidently an advantage over the heating in the atmosphere only because of the thorough heat-insulating quality of the hydrogen coating obtained around the iron, and because of the combustion of this gas at the surface of the liquid. The hydrogen actually burns in leaving the water electrolyte, and a part of this heat is conveyed into the iron. Taking this additional heat into consideration, the efficiency of the process is lowered still more, but at the same time the whole energy proves to be made better use of, the product of the electrolysis being utilized again for heating purposes.

Using a low E. M. F., 100 volts for instance, the heating is scarcely perceptible, although the current is about the same, probably because of the gas coating being thinner and the arc not long enough; 125 volts seems to be the critical voltage. By changing the poles we obtain oxygen on the iron cathode, which forms explosions in combination with the hydrogen chemically developed by the contact of iron and sulphuric acid. In this case the heating of the iron is again very low, probably because the amount of oxygen is only half the amount of the hydrogen disengaged in the reversed case, the gas coating not being thick enough to produce an effective arc, as was the case with the lower voltage.

The practical advantage of the process is undoubtedly in the total absence of oxidation of the heated metal, and this feature might probably lead to an extensive use of the process. For the experimenter the phenomenon of wrought iron melted like wax in a glass jar filled with water is one of the most striking imaginable.

A CURIOUS TRANSFORMER EXPERIMENT.

BY

Chas. Steinmetz.

Referring to the note on page 616 of No. 269 of The Electrical Engineer, let me say that the explanation of the experiment mentioned there is very simple. Inserting the U-shaped iron stampings, increases the brilliancy of the lamp by decreasing the reluctance of the magnetic circuit, the more, the larger the cross section of the air part of the magnetic circuit is, which constitutes by far the largest part of the magnetic reluctance. Hence, by separating the stampings, both sides of every stamping become available for the passage of the magnetism from the iron to the air, and the magnetic cross section of the air part of the magnetic circuit is very large. In pressing the stampings together, the cross section of the magnetic flux in passing from the iron is very much decreased, and thereby the induction decreased. Effect and cause are consequently identical with the spreading of the wires in Swinburne's hedgehog transformer. Since in a movable magnetic circuit such motions take place, which increase the total intensity of magnetism, the iron stampings repel each other.

If instead of U-shaped open stampings, O-shaped closed stampings be used, and the coil wound through them, the stampings would neither repel each other, nor would their distribution have any effect on the brilliancy of the lamp.

The above mentioned experiment can be varied very nicely, by having two sets of U-shaped stampings, one passing through the coils from beneath, and the other inverted ∩-stampings from above, the unlike stampings would attract, the similar would repel one another. By pressing the similar stampings together, or separating the unlike stampings the brilliancy of the lamp is decreased and *vice versa*. The explanation of this is obvious from the foregoing.

McEVOY'S HYDROPHONE.

This instrument, devised by Capt. McEvoy of the British Navy, was recently exhibited at a Royal Society Soirée. Its object is to give notice to a fleet or battery of the approach, under cover of darkness or fog, of a hostile vessel. It consists of two parts: an apparatus to be submerged at a distance of, say, three miles from the shore, and connected by an insulated electric conductor to an indicator on land, or on the home fleet. The former part comprises a heavy cast-iron case in which is a flat spring fixed at one end and free at the other. Upon the free end rests a short piece of roughened platinum wire, guided in an easy fitting hole. The spring is exceedingly sensitive to vibration, and responds to the slightest disturbance, although its movements are often so slight as to be invisible. If, however, an electric current be passed through it, and through the platinum wire and a telephone in series, a constant crackling is kept up, due to the rubbing of the wire in its guide. When placed in a building, the apparatus is never silent, the movement of the inmates and of vehicles outside being sufficient to keep it in action. Under the sea it is so efficient that the passage of a steamship within a mile is sufficient to set it in operation. Were it confined to communicating signals by telephone, its usefulness would be doubtful, as the observer would be sure to be away, or asleep, at the critical moment. But Captain McEvoy has devised a most ingenious and interesting device, by which the minute variations of current in the microphone are made to set in operation a bell and an electric lamp. In the telephone circuit there is interposed a delicate apparatus, like a galvanometer, with a finger moving over a considerable range. This finger takes up a position due to the current, and then two magnets are adjusted, one on either side of it. A variation of current causes the finger to approach one or other of the magnets, when it is immediately attracted and drawn firmly against the pole. In this way a new circuit is completed, a relay is operated, and a local battery set in action to work a bell or a lamp, or any other kind of signaling apparatus. There is thus no likelihood of the alarm being overlooked. We understand that the British Government are actively experimenting with this apparatus to determine its value in defending their English harbors from being suddenly entered by hostile cruisers or torpedo-boats.

MAGNETIC LEAKAGE DIAGRAMS.

BY W. S. DIX.

The accompanying diagrams are designed to assist calculations of magnetic leakage, and are based on Forbes' rules

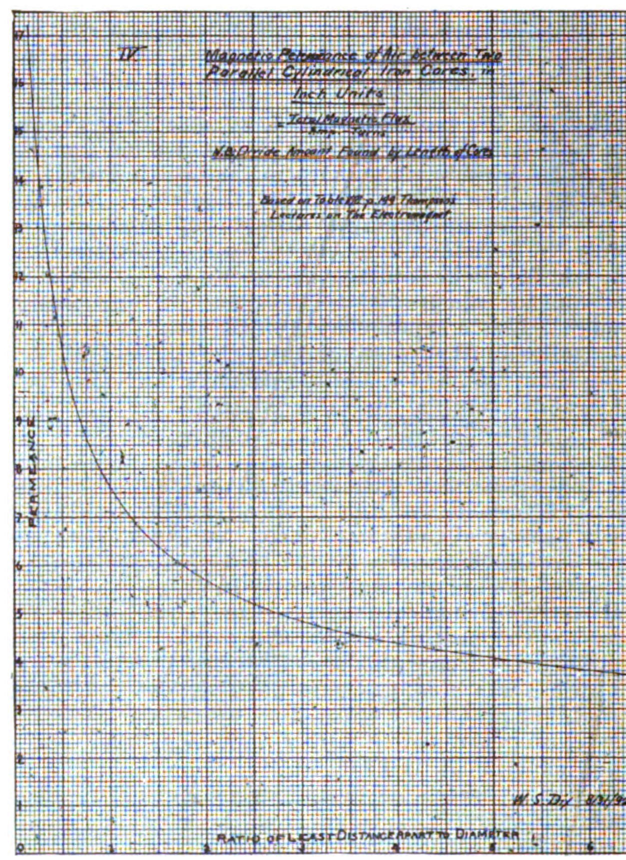


Diagram IV.

as given in Thompson's "Dynamo Electric Machinery," pages 187 and 188, fourth edition, and on Thompson's rule given on page 189, in his "Cantor Lectures."

Diagram I.—*Permeance between two parallel areas facing one another* equals:

$$3.192 \times \tfrac{1}{2} (A_1'' \times A_2'') \div d'',$$

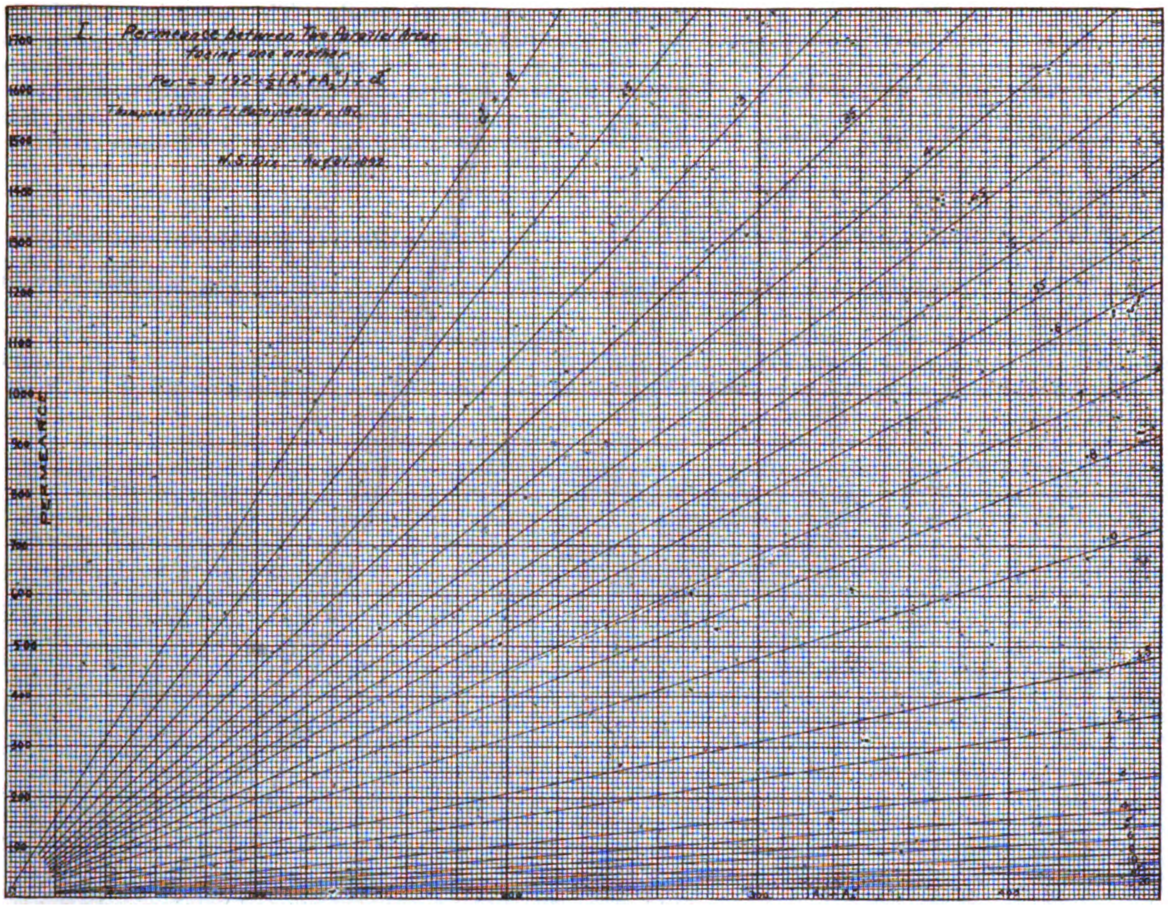
where A_1'' and A_2'' are the areas in square inches and d'' their distance apart in inches.

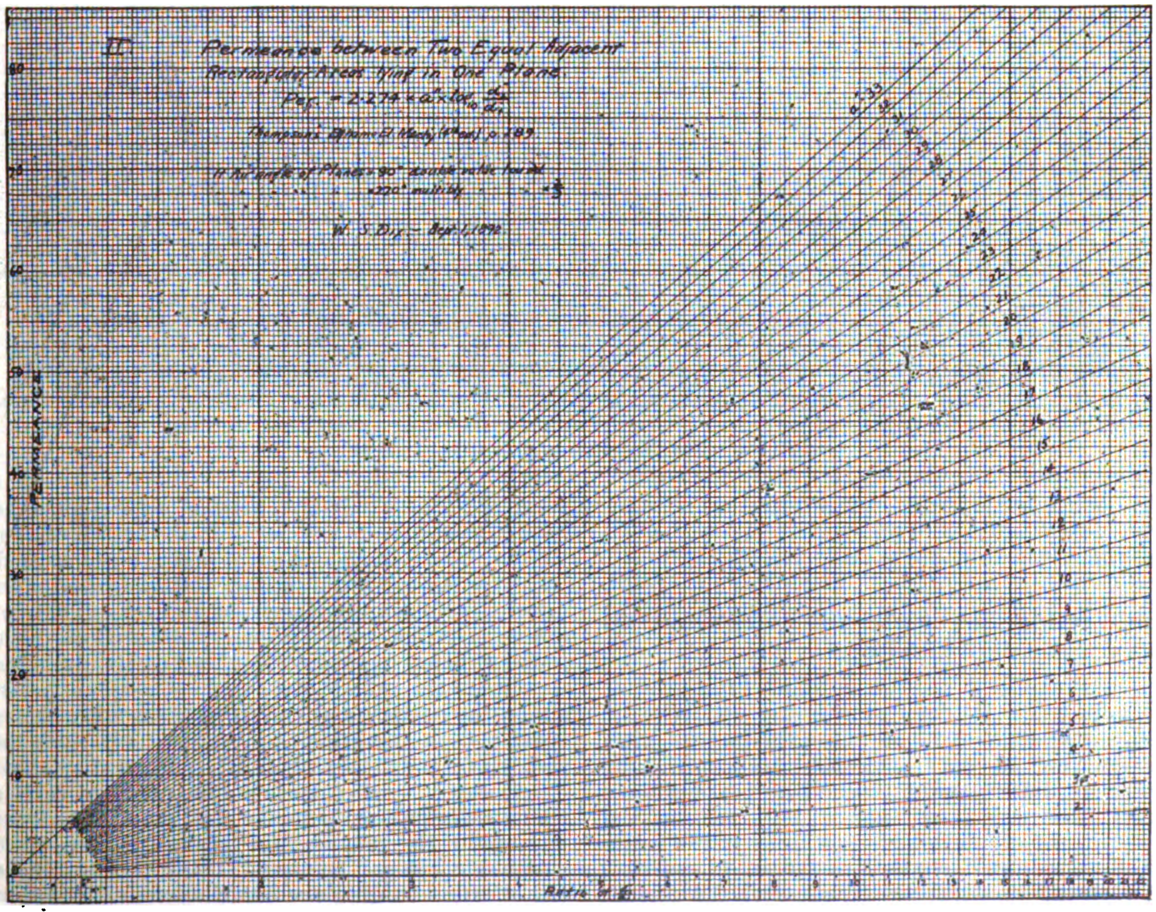
Diagram II.—*Permeance between two equal adjacent rectangular areas lying in one plane* equals:

$$2.274 \times a'' \log_{10} \frac{d_2''}{d_1''},$$

where a is their length and d_1'' and d_2'' the distance between their nearest and furthest edges respectively. If the angle of planes equals 90°, multiply the value found by 2, if the air angle is 270°, multiply by $\frac{2}{3}$.

Diagram III.—*Permeance between two equal rectangu-*





CHARTS I. AND II.—DIX MAGNETIC LEAKAGE DIAGRAMS.

lar areas lying in one plane at some distance apart equals :

$$2.274 \times a'' \times log_{10} \left(1 + \frac{\pi\,(d_2'' - d_1'')}{d_1''}\right)$$

where the letters signify the same as before. Multiply air angles of 90° and 270° by 2 and $\frac{2}{3}$ respectively.

DIAGRAM IV.—*Permeance between two parallel cylindrical iron cores* is independent of the absolute size of the machine, the ratio of distance apart to perimeter (or to the diameter) determining it alone. The permeance given is based upon Thompson's table in the work cited above, and is for one inch of core length ; hence the amount found should be divided by length of cores.

These diagrams will be found of especial use in laying out new types of machines, and will save considerable time in figuring out in logarithms what is at the best only an approximation, although with care, leakage can be figured to within two or three per cent. oftentimes.

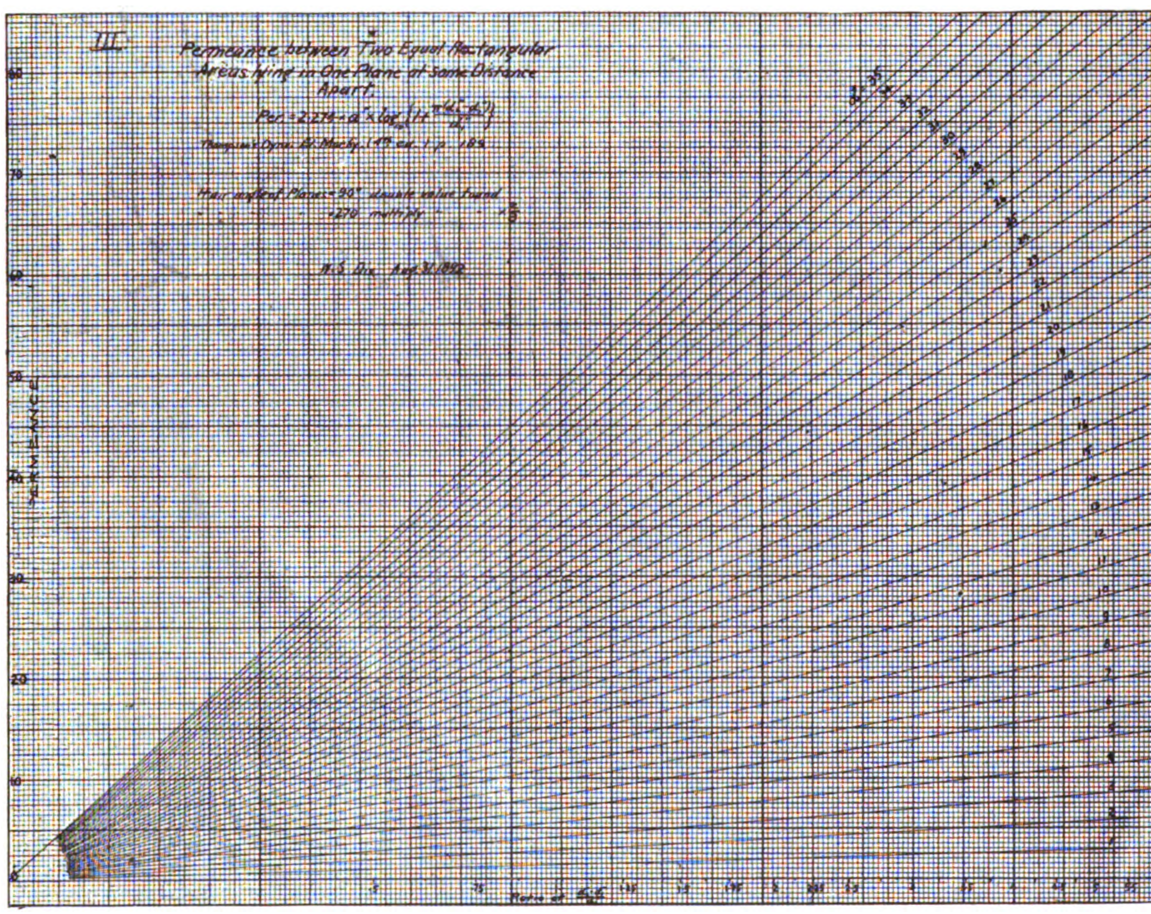


CHART III.—DIX MAGNETIC LEAKAGE DIAGRAM.

THE PHYSIOLOGICAL EFFECTS OF ALTERNATING CURRENTS.

AT a recent meeting of the Société Française de Physique, a note from Dr. Stephane Leduc was read, in which the correspondent points out that the physiological effects of alternating currents obtained from electrostatic machines are very different from those up to now observed with ordinary alternating currents of high tension and frequency. Thus, if the terminals are held in the hands nothing is felt, although a continuous stream of sparks is passing between the dischargers. If, however, the current is localized at one point on the skin by means of a rounded point, directly this point passes over a nerve, either sensory or motor, the nerve is excited throughout all its length beyond the electrode. The sensation felt in the sensory nerves allows of their distribution being accurately followed, while the least displacement of the electrode on the surface of the skin causes a cessation of all these effects. These currents can in this way be used to localize the seat of nervous excitation with much greater accuracy than has been hitherto possible.

REPAIRS TO SUBMARINE CABLES.

MR. F. A. HAMILTON, in an original communication to the *Journal of the Institution of Electrical Engineers*, gives the results of an extended experience of Trott and Kingsford's automatic grapnel for submarine cables and torpedo lines. This grapnel contains an insulated wire—a continuation of the heart of the grapnel rope—connected to an insulated metal disc, recessed in the crown of the grapnel. Pushes, which in their normal position are caused to project, by means of spiral springs of any desired strength, are inserted between the shank and prongs. These pushes are fitted with fine steel points, which, when driven in by pressure being applied to the head of the push, make contact with the metal disc, and consequently bring into action the battery and bell connected with the conductor contained in the grapnel. For ordinary work the springs respond to about 90 pounds ; but when the cable is much deteriorated weaker springs are used, in some cases responding to only 20 pounds. Mr. Hamilton advises that in paying out the grapnel rope for the first time, on no account should a "jockey" be used. The "jockey," he says, has the effect of bulging the outer layer. The rope will adjust itself after clearing the drum and sheaves, and the oftener it is used the kinder it becomes.

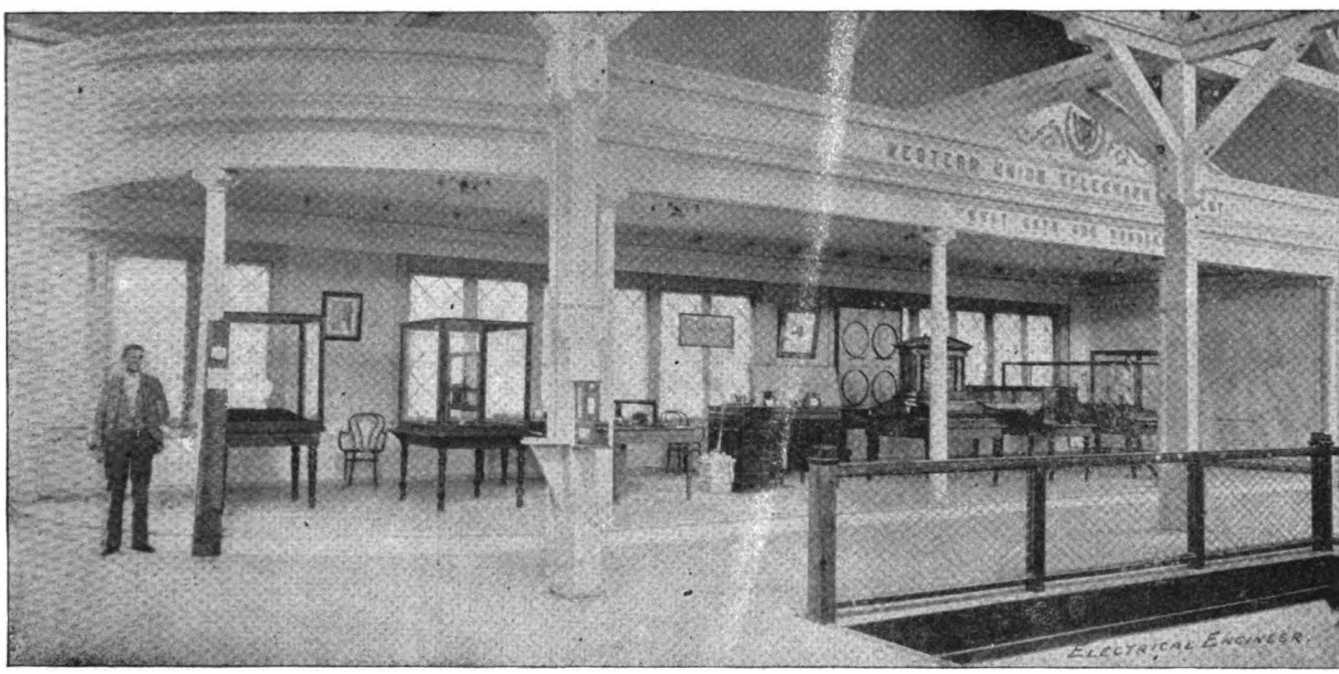
WORLD'S FAIR DEPARTMENT.

THE WESTERN UNION WORLD'S FAIR EXHIBIT.

The interesting display of the Western Union Telegraph Company occupies a prominent position in the east gallery of the Electricity Building. The exhibit is a popular one, designed more with a view to the telegraphic education and interest of the public than to impress technical men by an exhibition of new apparatus and methods, and to this end the space is entirely unprotected. Visitors are at liberty to inspect the apparatus and curiosities from all sides and to see the instruments in actual operation.

The section is divided between the two departments, telegraphy proper and cable work, and at either end stands a marble bust, the one of Prof. Morse and the other of Cyrus W. Field, typifying the two branches of work. At the telegraph end the first instrument to catch the eye is the original receiver made by Prof. Morse and exhibited at the University of New York in 1836. It is a very primitive looking affair consisting of a wooden frame at right angles to which is held an ordinary horseshoe electromagnet, actuating a second frame suspended from the first and carrying the tracing pencil. The mechanism for drawing the paper strip upon which the message is traced is simply an old clock train and weight. In the same case is shown the latest form of sound receiver for the purpose of comparison. The development of the modern instrument from the crude experimental one is most striking, while the principle involved is the same. Here are also photographs of the original message, "What hath God wrought."

A set of instruments for showing the working of the quadruplex system occupies a table near at hand. The other end of the line is on the main floor of the building, but is worked by means of an automatic sender at this end,—an ingenious device designed for the occasion by Mr. J. N. Johnson, the manager of the exhibit. These two exhibits are intended to show at a glance the advance from the early days of telegraphy to the latest development of the science. Two early messages are shown, framed; the one an original, bearing the signature of Daniel Webster, and the date 1851, while the other is the operator's transcript of a message received from a certain Mr. Hathaway in 1850 stating that he will take the first boat that leaves. It would be interesting to learn that he caught it, and, if not, when the next was due. But this is veiled from us. Here is also shown an automatic duplex circuit Wheatstone transmitter for high speeds from 350 to 400 words a minute and an ordinary stock ticker in operation. Some specimens of telegraph poles showing the destructive action of air, water, insects and birds in different climates, complete the telegraphic display.



THE WESTERN UNION EXHIBIT AT THE WORLD'S FAIR.

In the section presided over by the bust of Field are cases containing models of cable laying and repairing vessels, most prominent among which, of course, is that of the "Great Eastern." Then comes the "Mirror," the repair vessel of the Eastern Telegraph Co., with whose lines those of the Western Union connect in England for points in the east and also for Africa and Australia, and last, the "Relay," belonging to the Central and South American Telegraph Co. The Western Union lines alone connect with those of this company at Galveston, Texas. Sections of the original Atlantic cable hang upon the walls, and in a large case is shown the method of making and insulating a modern cable, each step being given from the crude rubber to the finished armored cable ready for deep sea service. Leaning against the case containing the model of the "Great Eastern," is the grapnel with which, on Sept. 2, 1866, Captain (afterward Sir James) Anderson recovered the broken cable of 1865 from a depth of 1,950 fathoms in mid-ocean. Previous to this

feat the greatest depth from which a cable had been raised was 500 fathoms. A profile chart of the ocean bed showing the route and positions of the ten existing cable lines, forms an interesting feature of this part of the display, as do also two large telegraphic charts of the entire world.

The latest development of the well known syphon recorder may be seen in operation in the centre of the space, while nearby is the old mirror system in which a ray of light was reflected from a small mirror carried on a small magnet influenced by the sending current, dots and dashes being indicated by the movement of the ray to one side or the other of the zero point of a scale. By this method one man was required to read the signals while another transcribed them, and, of course, no automatic record was possible. A Frier automatic transmitter for cable work, especially designed for the exposition, is used in connection with the syphon recorder.

The booth is brilliantly lighted at night by 85 incandescent lamps, and is full of interested visitors from morning till closing time. The exhibit is exceedingly well arranged and managed, and is one of the most successful in the building.

Mr. Johnson is assisted in the management of the exhibit by Mr. H. G. Spohr.

THE ATTENDANCE AT THE FAIR.

It is satisfactory to note that the attendance at the Fair is steadily if not rapidly increasing. The hope is that the average through July may reach at least 110,000 a day, and even much beyond that. On July 4, the attendance reached 324,344, of whom 283,273 paid the entrance fee. The total may reach $3\frac{1}{2}$ millions for July, at which growing rate the fond hope of Chicago, of beating the 24,000,000 total of Paris in 1889 may be realized. Expectations for Chicago have run as high as 40,000,000.

STANDARD INSTRUMENTS AT THE FAIR.—THE WESTON ELECTRICAL INSTRUMENT COMPANY'S EXHIBIT.

One of the most noticeable of the pavilions in the gallery of Electricity Building is that of the Weston Electric Instrument Company, of Newark, N. J., a view of which is given in the accompanying engraving, Fig. 1. It stands directly at the head of the stairs leading to that part of the balcony nearest the executive offices of the Department and irresistibly attracts the eye of everyone going up or down. Surrounding the entire space are show cases containing specimens of all the instruments made by the company; one of each range, besides a number of special instruments not described in any of their catalogues, and merely shown here to demonstrate the adaptability of the Weston standard instruments to all imaginable purposes. In the central show case are four large boards with all the parts, from the largest to the smallest, of four main types of instruments.

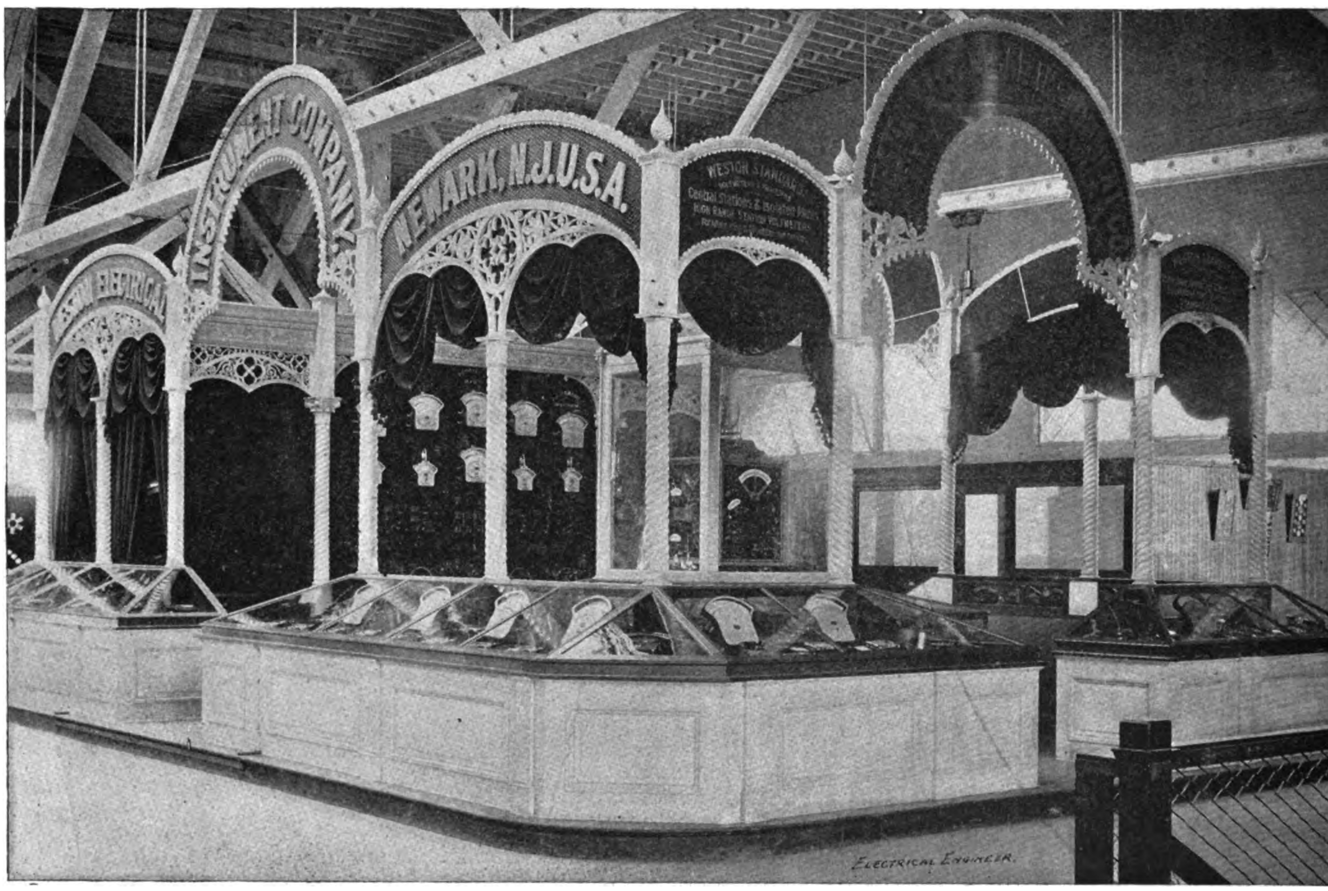


Fig. 1.—The Weston Electrical Instrument Co.'s Exhibit, World's Fair, Chicago.

The first board, facing the main entrance, contains the portable and laboratory standard voltmeter. The next, passing to the right, shows the parts of the ammeter, milliammeter and "volt-ammeter," a combination of a voltmeter and ammeter to be used as separate instruments, and not to be confounded with a wattmeter.

The third board is shown in Fig. 2. On this are fixed the parts of the illuminated dial and isolated plant voltmeters and ammeters. The arrangement of the magnetic system inside the iron case is shown and a section is made through a so-called astatic ammeter showing its peculiar internal construction. This instrument is absolutely unaffected by external magnetic influence as will be evident from a glance at the engraving. It is of the electromagnetic type and the magnetic circuit is arranged much

like that of an iron-clad dynamo. This board also shows that the station voltmeters are constructed similarly to the portable standard instruments and are possessed of the same valuable properties. On the fourth and last board are the parts of the alternating and direct current voltmeter and the mechanism by means of which the instrument is made aperiodic is shown in detail.

Above the boards and in the same case is a double coil tangent galvanometer, an historic relic of some value and interest, as it was used in Mr. Weston's laboratory to standardize the first instruments at the time of their construction. The galvanometer was made with the greatest mechanical skill possible at the time and was thought to be one of the very finest made. With the introduction of electric railways in the neighborhood, however, its constant was found to differ from day to day and its use was therefore abandoned. The instruments now exclusively used for the purpose are laboratory standard voltmeters and ammeters, which have the specific advantage of not being disturbed by external magnetic influences, and which in the case of those in use in the laboratory of this company, have remained almost absolutely constant for more than three years.

New and very original designs of portable and laboratory standard rheostats and bridges are shown in a row of lower cases surrounding the large centre one. It is well known that the general practice in this class of instrument is to place the brass blocks on the top of a hard rubber base. In these, however, this has been changed and the blocks are placed within the box and the under side of the hard rubber top, which is perforated to admit the plugs. The cost of the instrument is thus materially lessened, as it is unnecessary to finish the brass blocks, and is claimed, besides, to decrease the liability of error from the accumulation of dust and moisture. All the coils are made of an alloy without temperature coefficient, patented by Mr. Weston as early as 1889 and used extensively at present in voltmeters and ammeters. It is thus possible to construct an instrument absolutely compensated for changes in temperature. The standard cell without temperature coefficient, one of the most important recent inventious of Mr. Weston is also exhibited, and was fully described in THE ELECTRICAL ENGINEER of April 12, 1893.

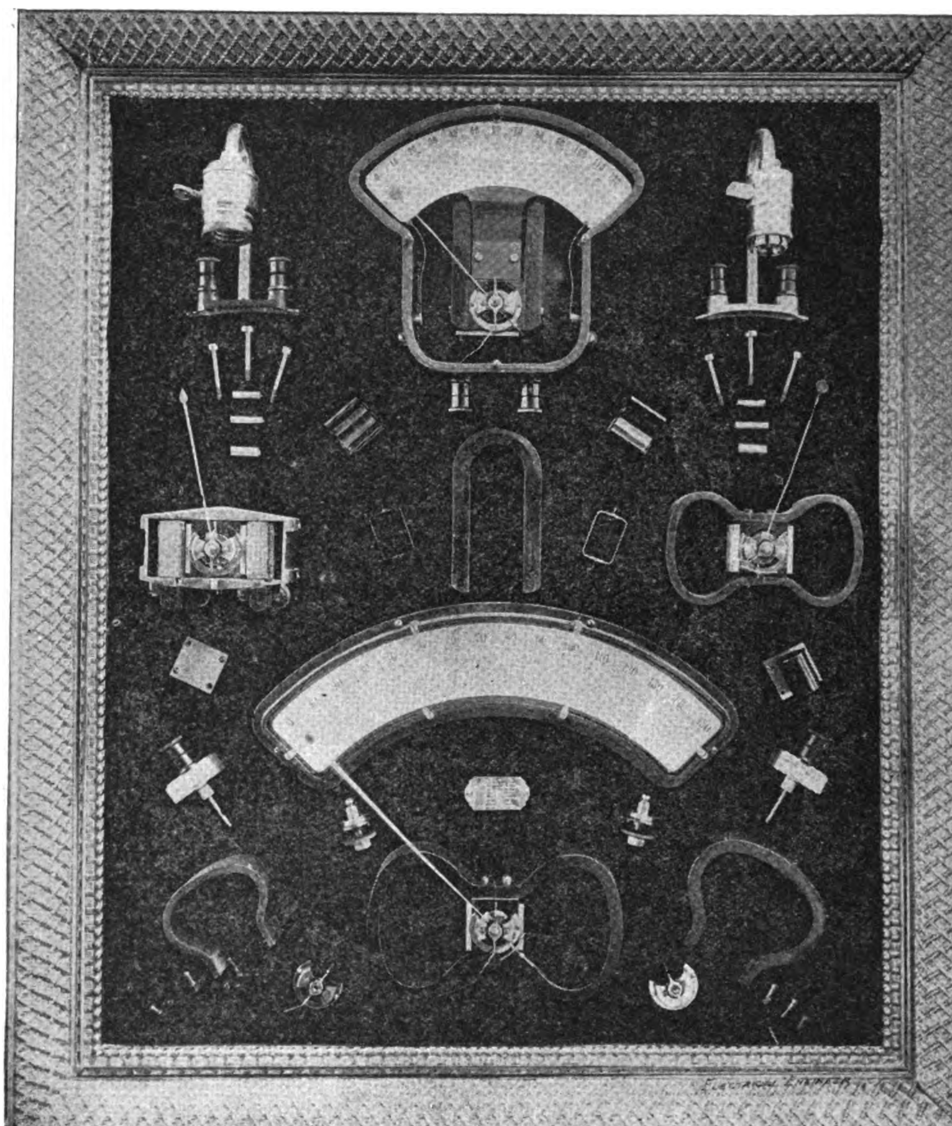


FIG. 2.—PARTS OF WESTON ILLUMINATED DIAL AND ISOLATED PLANT INSTRUMENTS.

Standard instruments of all kinds are displayed in cases about the outside of the space. Commencing at the right of the front entrance are portable standard ammeters and voltmeters. As mentioned before, great improvements have lately been made in these instruments, so that now by the use of the alloy without temperature coefficient portable ammeters, up to the highest ranges, may be permanently left in circuit without being seriously affected by atmospheric change in temperature or the heating action of the current. This is, of course, also true of voltmeters and milli-voltmeters. Next to these come station voltmeters and ammeters, and on the opposite side of the entrance are shown voltmeters and wattmeters for alternating and direct current, while still another case contains instruments for isolated plants. All around the space are illuminated dial voltmeters and ammeters and at the two front corners are standard instruments for laboratory use. A large switchboard made of slate in excellent imitation of antique occupies the outer wall of the office directly behind the large centre case. It is beautifully worked. At its base is a slab of what appears to be, even after close examination, the purest onyx. It is only slate, but the imitation is so close that the piece deserves to rank almost as a work of art. The dark color of the slate is cleverly made use of, showing slightly through the enamel with which the surface is covered and giving the most deceptive effect of translucence imaginable. This beautiful work is from the factory of T. J. Murphy, and forms in itself a most interesting exhibit.

On the board are the necessary ammeters and voltmeters to show four distinct circuits for four machines, and at the bottom are four Carpenter enamel rheostats. The switches

are exhibited by C. S. Van Nuis and are of the well-known "Ajax" pattern. The centre panel of the board is an ammeter of 1,500 amperes capacity, showing the total output of the system. Below this is a potential indicator for connection to the main bus bars The large switch in the centre is of 1,000 amperes and is used for changing from the two to the three-wire system. On the "onyx" shelf is a ground detector by means of which the condition of the circuits may be constantly tested and the insulation resistance determined by a mechanical computing device and without tedious calculation.

In the office are shown in operation a number of special instruments, including a photometer in combination with a wattmeter, and laboratory standard instruments. The walls are covered with station instruments and photographs of switchboards equipped with the company's devices. Prof. Richard O. Heinrich, in charge of the exhibit, has made it even more attractive than before the small fire that destroyed most of the interior some weeks ago, and is now kept busy imparting information and dispensing hospitality to the general public and the company's friends.

COLUMBIAN EXPOSITION ENGINEERING MEETINGS.

Mr. Max E. Schmidt, Secretary of the General Committee of Engineering Societies, Columbian Exposition, sends us the following:

Informal gatherings will be held in the rooms of the Associated Engineering Societies, No. 10 Van Buren street, every Monday evening from 8 to 10 p m.

Members and their friends are cordially invited to be present to meet foreign and visiting engineers.

The Chicago engineers are specially requested to call at the rooms when in the vicinity, if only for a minute, in order to inspect the register on file, so as to ascertain which of their friends are in the city, and to assist in entertaining them and foreign engineers.

THE FIRE INSURANCE CONGRESS AT THE WORLD'S FAIR.

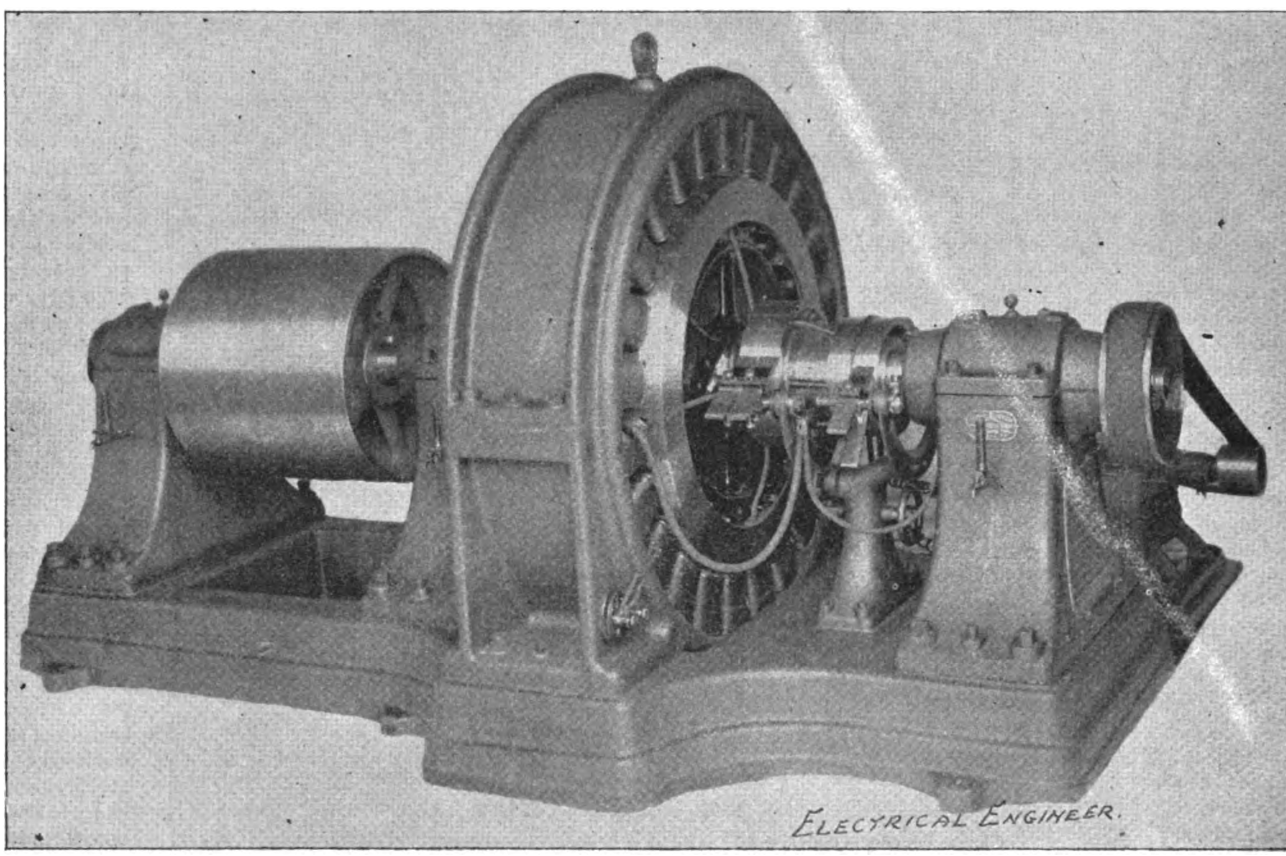
During the recent Insurance Congress in connection with the Columbian Exposition, interesting papers on the relation of electricity to the subject of fire insurance were read by W. J. Jenks and C. J. H. Woodbury.

THE WOOD IRON-CLAD SLOW SPEED ALTERNATOR IN THE FORT WAYNE EXHIBIT.

An interesting addition being made to the exhibit of the Fort Wayne Company in the Electricity Building is the 3,000-light, slow speed, iron-clad alternator recently designed by Mr. James J. Wood and shown in the accompanying engraving. This machine embodies a number of novel features. It is symmetrical in design, with large bearings, and the various parts are made as light as possible to facilitate handling without the use of special machinery. The shunts for the exciting coils are placed in the main pillow block out of the way of injury, and the brushes for both the alternating and exciting current are on a separate pedestal, those for the exciting current being very accurately adjustable by means of a small hand wheel. They are, besides, in independent pairs, making it possible to remove one at a time while the machine is in operation.

The spiders are of iron and the armatures are built up of small laminated C-shaped stampings. The amount of wire is very small, while the output is said to be greater than in any other machine built. The main frame, it will be noticed, is cut away to allow the belt to pass through the floor if desirable. The bearings are self-oiling, self-aligning and are hung on iron pillows separate from the main pillow block, allowing for ventilation and also giving more space for oil. The exciter wires are connected on the lower side of the machine to small insulated terminal blocks.

Another valuable feature of the machine is that the draft from the rotating armature is used to ventilate both the crown and the pillow blocks. The air is forced into the crown whence it issues at the bottom into channels leading it to the pillow blocks. It thus traverses the entire machine and keeps it cool, as the armature itself remains cool even under extreme loads. The exciter is of Mr. Wood's new iron-clad slow speed type.

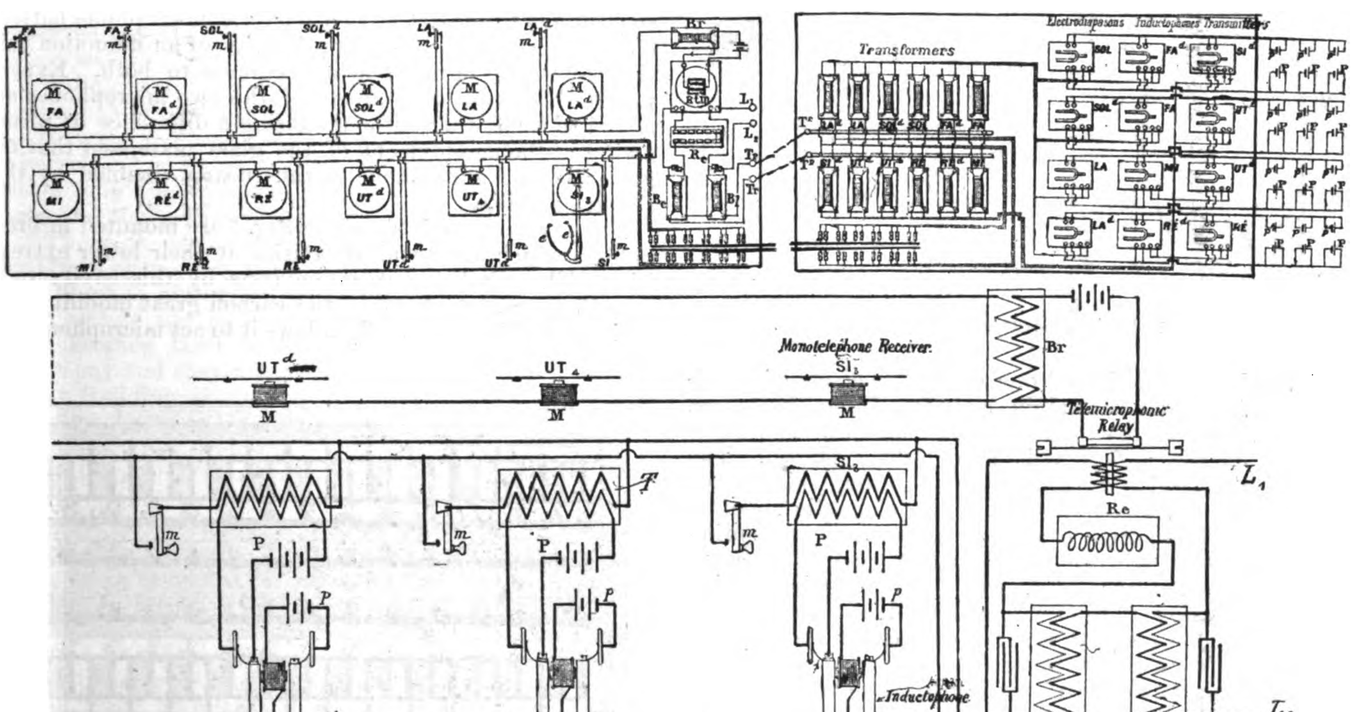


The New Wood 3,000-Light Ironclad Alternator, World's Fair, Chicago.

MERCADIER'S TELEGRAPH AND TELEPHONE EXHIBIT AT THE WORLD'S FAIR.

Mercadier Bi-Telephone and Transmitter.

THE apparatus exhibited by M. E. Mercadier is situated in the space occupied by the French Administration of Posts and Telegraphs in Electricity Building. The exhibit comprises a multiplex telegraph system, the "bi-telephone" and a new microphone system. The multiplex telegraph is placed in the centre of the exhibit of the French Administration of Posts and Telegraphs and occupies two tables arranged symmetrically. On each table there is placed a complete terminal station with twelve "legs." The two terminal stations are connected by means of an artificial line made up of a combination of resistances and a variable capacity so as to imitate the conditions of an external telegraph or cable circuit, and which will be described later.



FIGS. 1 AND 2.—THE MERCADIER SYSTEM OF MUTIPLEX TELEGRAPHY, WORLD'S FAIR.

The accompanying diagram, Fig. 1, shows the general arrangement of the two tables representing a receiving and a transmitting side of a system designed for the transmission of twelve messages simultaneously. Fig. 2 shows in detail the manner in which the signals are received and transmitted without interfering with each other.

Referring to Fig. 2, it will be seen that the electrically actuated tuning forks are constantly vibrating and sending the intermittent currents from batteries P into the primary wires of the induction coils to which they are connected. When the key *m* of station si_3, for instance, is depressed, the induced currents produced by the induction coil brings into action the primary circuits of the two induction coils B_1 (line induction coil) and B_e (extinction induction coil). The secondary induced currents produced by these two coils, acting differentially on the telemicrophonic relay do not affect the latter. In this way transmission passes to line without affecting the receiving relay.

When receiving, the secondary currents sent by the corresponding transmitter at the other end of the line pass from the line or ground L_2 into the secondary circuit of the coil B_1, and to the line coil of the telemicrophonic relay; the diaphragm of the latter acts upon the microphone contacts, and the induced currents produced in the induction coil Br of the relay pass into the monotelephonic electromagnets and vibrate their plates respectively. Each of the plates of these monotelephone receivers is tuned to respond to only one fundamental note, which corresponds to the number of vibrations sent out by the corresponding tuning fork at the other end of the line.

The theory of the monotelephone has been the subject of extended inquiry by M. Mercadier, and its practical application in this special system of multiplex telegraphy has been greatly facilitated by the results of his researches.

With the arrangement as shown in Chicago, any combination of numbers, so far as transmission and reception is concerned, can be effected; thus twelve messages can be sent simultaneously in either direction, while any less number can, of course, be transmitted either way and in any proportion of twelve. It is also evident that the same wire can be used for Morse or Wheatstone transmission, while the wire is simultaneously transmitting the rapid alternations required by the Mercadier system, as those do not interfere with the current of the former.

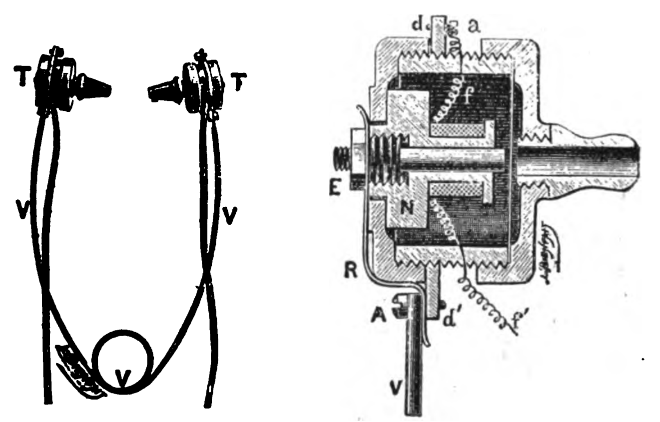
In one of the cabinets included in the exhibit there is also shown a microtelephonic station consisting of an ordinary microphone combined witha Mercadier "bi-telephone."

M. Mercadier has made several types of this instrument, by employing telephones of one or two poles connected by a steel wire spring two millimetres in diameter, seen at V, Fig. 3, which shows, reduced to quarter size, one of these instruments. The boxes, T T, are of ebonite, the covers

terminating in rubber ear nipples, which may be taken off and changed at will and which extend into the interior of the ear. It is held in place close to the auditory passage, assisted by the light pressure of the spring. These telephones weigh not more than 120 grammes (while those in ordinary use weigh about 400), do not exceed four centimetres in diameter, and produce no fatigue or pain even after prolonged use.

The steel spring connects electrically two of the four ends of the bobbins, so that two flexible cords are sufficient to connect the instrument to the telephone set. The spring may also be magnetized so as to reinforce the magnetism of the telephone cores. It plays, therefore, a triple role—mechanical, electrical, and magnetic.

In spite of the feebleness of its field, the loudness of this telephone is equal to that of the instruments in ordinary use, while the clearness is greater. This fact has been established by tests on subterranean lines 50 to 74 kilometres in length, on one telephone line 800 kilometres long, and on the line between Paris and London, and that, independent of the transmitter employed.



FIGS. 3 AND 4.—THE MERCADIER BI-TELEPHONE.

Fig. 4 shows a section of one of the receivers of a "bi-telephone," having a straight magnet of the Bell type. The illustration shows the instrument full size. The triple function of the spring V is here clearly shown. The mechanical function results from its form, which tends evidently to exercise a pressure. The magnetic function is exercised through the steel strip R, connecting the spring with the magnetized core N of the electromagnet by means of the screw A and the nut E. Finally the electric function results from one end, *f*, of the bobbin of the electromagnet, being connected with the metallic collar *d d'* by the screw *a*, and thus to the spring V by the screw A.

Experiments have shown that the "bi-telephone" notwithstanding its small dimensions is as powerful as the ordinary telephones. Being held in position automatically it thus leaves the hands free for writing, while it permits at the same time of operating a special switch for short-circuiting the resistances and thus avoiding self-induction. In the same way, when listening, the secondary circuit of the induction coil can be short-circuited; when speaking, three quarters of the "bi-telephone" circuit is short-circuited, one-quarter of the circuit remaining on the line. In Europe all telephone stations are provided with two telephone receivers, so that a device of this kind is exceedingly convenient.

In the microphone employed in this system due to Messrs. Mercadier and Anizan, these inventors have employed carbon pencils, in order to avoid the "packing" which frequently occurs when powdered or granulated carbon is used. The results obtained with the carbon pencils, although appearing to be less intense at the start are better in the long run because they assure long and regular action; besides this, the carbons of MM. Mercadier and Anizan are arranged in such a way that the points of the microphone contact can be changed when sputtering sounds are noticed. The group of carbons is fixed at the centre of a glass plate, glass being chosen because of its homogeneity which avoids the effects of resonance met with in wooden diaphragms.

The microphone exhibited shows, in fact, that owing to the employment of the glass plate it is possible to arrange

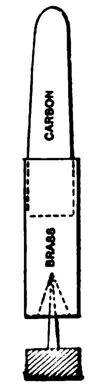


FIG. 5.

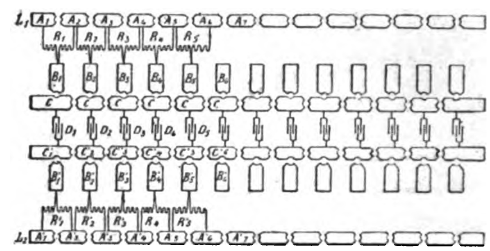


FIG. 6.

on the same plate of glass, one behind the other, two groups of carbons each insulated from the other. These two groups form part of two separate microphone battery circuits and of two separate primaries of an induction coil, the secondary of each being common to both. Experiments show that the effects of the two microphones are added to each other without causing a difference of phase, owing to the employment of the glass plate, and that the power of the microphone is thus nearly doubled by this simple expedient.

The carbon pencils shown in Fig. 5 are mounted in brass holders which have conical cavities at their lower extremities. The whole combination rests by this cavity on a metallic point which gives the carbon great mobility, and which, as will be seen, only allows it to act microphonically

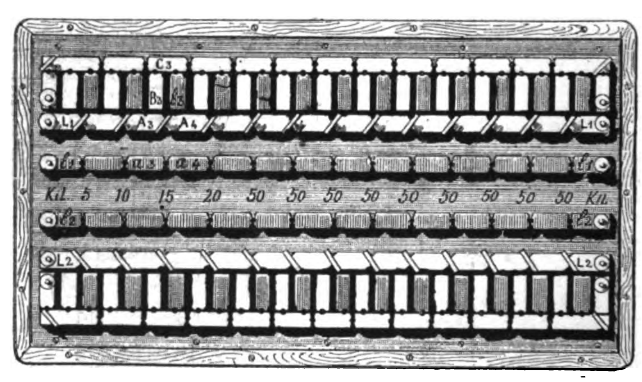


FIG. 7.—ARTIFICIAL TELEGRAPH LINE.

at its upper part. It may be remarked here that when carbon pencils are arranged vertically and suspended microphonically at both ends it is impossible to avoid a difference of phase, the lower part acting at the same time as a microphone contact and as a pivot. Besides this the microphone is provided with an arrangement so that it can be used either for local or long-distance service.

The various apparatus described above, as has already been remarked, is operated through an artificial line. The latter is arranged on the system of MM. Branville and Anizan, and constitutes the equivalent of ærial lines or cables, being so arranged that both ohmic resistance and capacity can be varied to correspond to conditions existing on an actual line.

The engraving, Fig. 6, shows the general construction of

this combination, and is so clear as to require no further explanation. Fig. 7 shows the top of the case containing an artificial line. These resistances and capacities can be placed either in series, in parallel or in any desired combination, and hence enable one to imitate all possible line conditions. For those experimenting in telegraphy and telephony and in telegraph offices where artificial lines are frequently required, the combination ought to prove of considerable value.

This excellent exhibit is in charge of M. Anizan.

OPENING THE WORLD'S FAIR AT NIGHT.

OPENING all the Exposition-buildings at night has proved to be of no special advantage to either the public or exhibitors, while it has been unnecessarily expensive. So the Exposition management and department chiefs are discussing, according to the *Chicago Tribune* of July 3, a recommendation to the Director-General that the number of buildings open be limited to two every night. The idea is that all except the Electricity and one other Building be closed. The Electricity Building displays furnish the only really night show exhibits in the park, and it, they think, should be kept open always, while the opening of the others should be one each night, alternating among them. The department chiefs being at the head of the great exhibit buildings are in touch with the exhibitors and have observed the effect of opening all the buildings. They say it is a waste of electric lighting, for the night crowds in the buildings are not sufficient to warrant the exhibitors in keeping their displays open, and consequently there is little to be seen, and the people flock around the grand basin, where there is music and animation. At the Paris Exposition only the main building and one or two others were open and that was a well-managed show.

"There is no reason whatever for keeping all these buildings open every night," said one of the chiefs recently, "for there is nothing special for the crowds to see and they merely use them as avenues. The exhibitors who tried keeping their displays open at night found that it didn't pay and they are covering them up. Now the Electricity Building should, of course, be open. Its exhibits can only be appreciated at night. Then there should be one other. Say to-night Transportation, the next night Agriculture, the following night Manufactures, and so on. Let the nights be designated as Mining night, Manufactures night, Fisheries night, and so on for each of the buildings as they are open. The people would then understand when they come to the park at night just what building besides the Electricity Building would be open. It would be practical then to have music in the two open buildings."

There is another side to this question and that is the proper policing of the buildings. With the cutting down of the force of guards it will be impossible to properly protect all the buildings at night from thievery. A moderately large crowd is in itself a measure of protection against theft, for some one will see the thief. Take, for instance, the isolated visitors, who wander around at night in the big Manufactures Building. It is an easy matter to steal there, for there are not sufficient guards. If only two buildings were open, the guards who are now nightly scattered through 10 exhibit buildings could be concentrated.

THE ELECTRIC LIGHTING OF THE WHITE CITY.

WE take the following from the *New York Times*, of July 8:

He who has not seen the World's Fair at night has not seen it at all, and has missed the very finest piece of scenic pageantry this vale of tears affords. The stage of the pageant is a floor of smooth landlocked water, 350 feet in one dimension by 1,000 in the other, bordered on all sides by great white palaces that are vaster and more spectral by night than by day.

On one of the shorter sides it is backed by the domed Administration Building so set back as to leave an ample foreground some 200 feet in depth by the width of the great basin, and as soon as darkness falls this foreground is packed with people waiting for the show. Directly in front is the monumental fountain, the Triumph of Columbia. On either hand of it is a circular basin filled with heaps of stonework that represent by day what at night become the electric fountains.

As the darkness deepens, and the blue of the sky behind the colonnades of the opposite peristyle becomes a dusky gray, suddenly a serried row of lights appears to mark the cornice line of the buildings that border the basin, and of those that are withdrawn from it at the west side and flank the Administration Building. This uniform line was one of the devices agreed upon by the architects to secure unity and totality to the sum of their various constructions, and it is emphasized in a wonderful way by the row of level lights that is broken only at the centre of the Manufactures Building by the higher row that marks the cornice of the central arch, and by the definition in lines of light, of the gables of the buildings of Agriculture and of Electricity, and by the continuation of the line around the semicircular portico of Machinery Hall.

Far below, at the water's edge, another continuous line of white lights springs to view, completely surrounding the great water court, mirroring itself in the scarcely rippled surface, and illuminating, as the footlights of the spectacle, the procession of ghostly launches and of gondolas gay with Chinese lanterns that continuously makes its way from left to right around the basin.

The best place from which to see the coming show is from one or other of these craft. From the water the Administration Building is the dominant feature of the whole spectacle. The two terraces from which the dome rises, the one a spreading square, the other withdrawn and truncated at the corners that bristle with groups of statuary into an irregular octagon, are bounded with rows of electric sparks, while a cunning arrangement of unseen lights illuminates the red background, against which the shapely Doric colonnade is relieved. Above, on each of the four long sides of the octagon, is a row of eight brazen standards bearing torches that burn with a lurid, waving, smoky glare against the white drum of the dome, and that contrast with the white and steadfast lustre of the rows of light below and of the train of light above, for the base and the ribs of the soaring dome are outlined in light and a crown of light surmounts it.

From the lake, from the basin, from the lagoon, and from the grounds this diadem of fire is dominant, so effectively lit that it seems to have been designed expressly for the illumination.

As the launch slips noiselessly along over the lighted water, one of the bands on either hand of the Administration Building breaks forth into martial music, and from the ridge of the Manufactures Building the vivid white bull's eye of a search light is turned upon the scene. It brings out into sharp relief and an intenser whiteness than that of daylight the lithe and defiant figure of the seated Columbia, with her attendant carswomen, the plunging horses of the basin, and the jets of foaming water that shoot between and over them. Then it sweeps down upon the huge "Republic" at the other end, and the sheen of it upon the figure and the drapery induces one for the first time to forgive the sculptor for permitting his work to be gilded.

Again the spreading white swath of light is lifted and veered so as to bring into sharp visibility in turn the pure lines of the Agricultural Building, the groups of sculpture that relieve its sky line, and the low domes and incrusted steeples of Machinery Hall, and then sweeps upward toward the zenith, followed by the widening belt of darkened sky, that the contrast turns from purple to black:

> "Full half the height of heavens blue
> That monstrous shadow overflew."

And now the playing of the electric fountains begins, a play of water and of fire. A central jet is surrounded by a ring of lesser jets, at first in as pure and dazzling white as shooting water shows under the search light, then in living green and rose color and intense violet, but changing and shifting in shapes as well as in colors while the spectacle lasts. The smaller jets become at last a ring of sheaves in blinding white, while the central shaft of water goes through all the hues of the electric spectrum, and finally is shot up in a pure white geyser to its utmost height of something like a hundred feet and the wonderful show is over.

The show is over, but the crowd does not disperse. The rings of living light still surround the basin, the terraces of light define the building at the back, the red torches still glare and wave above them, and over them again the diadem of light still stands in steady lustre, the band is still blaring from the stand, and the processionists in the gondolas are joining the refrain of its melodies. Not until the hour of closing approaches does the crowd assembled upon the plaza begin to make its way homeward, leaving a spectacle such as not one of those who compose it has ever seen before, and as not one of them can ever forget.

MR. HENRY GOEBEL, of incandescent lamp fame, is attending the Fair in company with his daughter. Mr. Rhotehamel, of the Columbia Lamp Company, has also been in town for several days and has had the pleasure of entertaining Mr. Goebel, besides showing him the sights of the "White City."

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XVI. NEW YORK, JULY 12, 1893. No. 271.

CANDLE POWER OF CITY ARC LAMPS.

IT is now nearly fifteen years since arc lighting was introduced and operated on a commercial scale for private and public illumination, and it might be supposed that some standard of value would have been determined upon long since; yet such, unfortunately, is not the case. The reason for the lack of definiteness in the establishment of a standard of candle power for arc lamps is undoubtedly due to the great variation observed in the light emitted from such a lamp depending upon the angle and other conditions under which the light is measured. Hence it is that ever and anon we hear of alleged frauds practiced upon municipalities by electric lighting companies by the operation of arc lamps below contract candle power; and the local newspaper accounts are usually accompanied by the reports of candle-power tests made by some local city functionary—usually the city chemist—whose report is accepted without further inquiry as to the methods employed or other details of the tests.

A recent instance of this kind is the hue and cry raised over the arc lights illuminating the streets of the city of Buffalo, which were reported below candle-power according to the tests of the city chemist of Buffalo. Not satisfied, and naturally so, with this report, the company itself retained Prof. R. A. Witthaus of New York, Mr. F. P. Vandenbergh of Buffalo and Mr. J. E. Randall of Lynn, Mass., to make an independent test. These tests were made on three different types of lamps designated as of 2,000 c. p. nominal, the results of which are shown in the following table:

	No. observations.	Av. c. p.	Max. series.	Min. series.
Thomson-Houston M. 2..	140	2,301.3	2,459	2,097.1
Wood..................	60	2,121.4	2,356.7	1,986.1
Brush..................	60	2,206	2,184.4	2,138.8

The lamps during the entire time were all in the same circuit, and different tests were made of lamps in five separate circuits with from 51 to 58 lights each, which showed the candle-power to vary from 2,191 to 2,784 candle-power.

These tests were conducted with a Bunsen bar photometer made by the American Meter Company. A 50 c. p. incandescent lamp was compared with standard sperm candles, the distance between lights being 100 inches. This incandescent lamp was then compared with an arc light, the distance between the lights been 360 inches, or 30 feet. The observations were made in a specially prepared room from which all light was excluded, the comparisons being made direct and without the use of any reflectors. The carbons used were ½ inch in diameter, plain, and taken from the regular stock. During the photometrical observations the electrical conditions were noted; the voltage varied between 45 and 55, and the current averaged 9.75 amperes. These tests were made in the presence of representatives of the city including the city chemist, Prof. Hill, who made the recent report, and under proper conditions; and now we learn that the latter gentleman has acknowledged that his method of making tests out of doors was not accurate.

It must be obvious to anyone who has had anything to do with photometrical measurement that the errors which are likely to be introduced in such work require careful guarding against even in the laboratory, and that an outdoor measurement, under the most favorable circumstances, can be nothing but the roughest approximation.

We cite the Buffalo case merely to draw attention to the condition of affairs which makes the recurrence of these unjust charges against electric lighting companies possible. Judging from the figures given, the power of the arc lamps was measured under the most favorable angle, which for the purpose of the test under consideration was quite justifiable. But the term 2,000 c. p. nominal is one which has given rise to so much vexation that it is time that steps were taken to define it more particularly; it is therefore to be hoped that the proposition brought before the Electrical Congress in Chicago in August next will result in definite action. This resolution reads as follows:

"The term 2,000 c. p. is to mean an arc produced by 10 amperes and 45 volts potential difference between the carbons, or a 450-watt arc. The candle-power of arcs produced by currents of more, or less, amperes, or more, or fewer, volts difference of potential, to be rated proportionally."

With a rule of this kind to guide him, even the city chemist can determine whether the city contract is being fulfilled; and the station superintendent will find it most convenient for determining whether his apparatus is operating under standard conditions.

The resolution as worded above does not, it must be admitted, involve a strictly scientific method of estimating the candle-power of an arc lamp. But for purposes of rough comparison, and more particularly as a basis for a contract, it answers the purpose sufficiently well. Even if not adopted in that particular form some such standard of reference ought to be decided upon. Electric light is a commodity to be sold by measure as much as cloth or wheat, and it is to the welfare of the industry that exactitude of measurement tends.

ELECTRIC RAILWAY DEPARTMENT.

A 30-TON ELECTRIC LOCOMOTIVE FOR THE GENERAL ELECTRIC COMPANY'S WORLD'S FAIR EXHIBIT.

THE rapid extension of suburban and interurban electric lines demonstrates pretty conclusively that it is only a question of time,

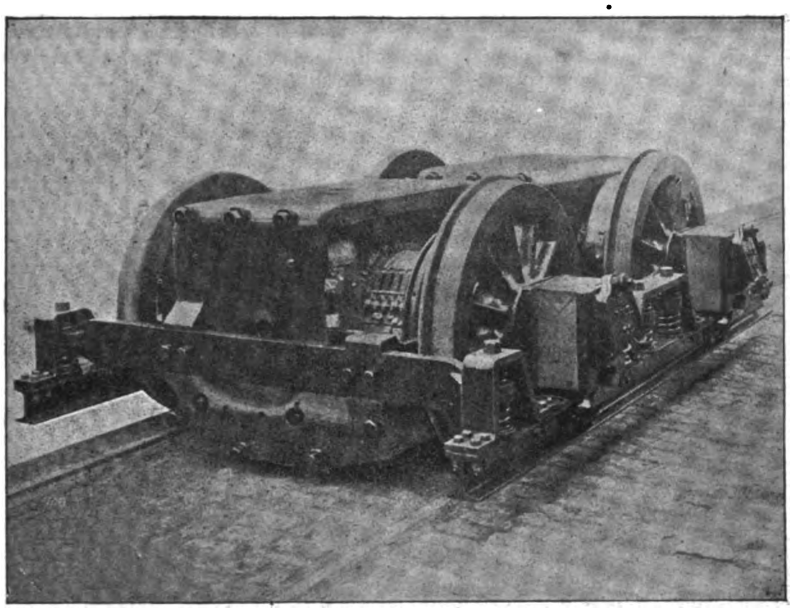


FIG. 1.—MOTOR TRUCK OF 30-TON ELECTRIC LOCOMOTIVE.

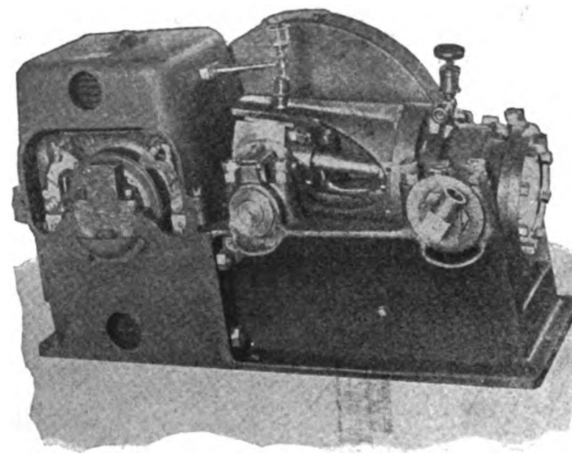


FIG. 4.—ELECTRIC AIR COMPRESSORS.

and a very short time at that, when not only passenger but heavy freight traffic will be carried on with electric motive power. This will of necessity require heavy locomotives, and the engineers

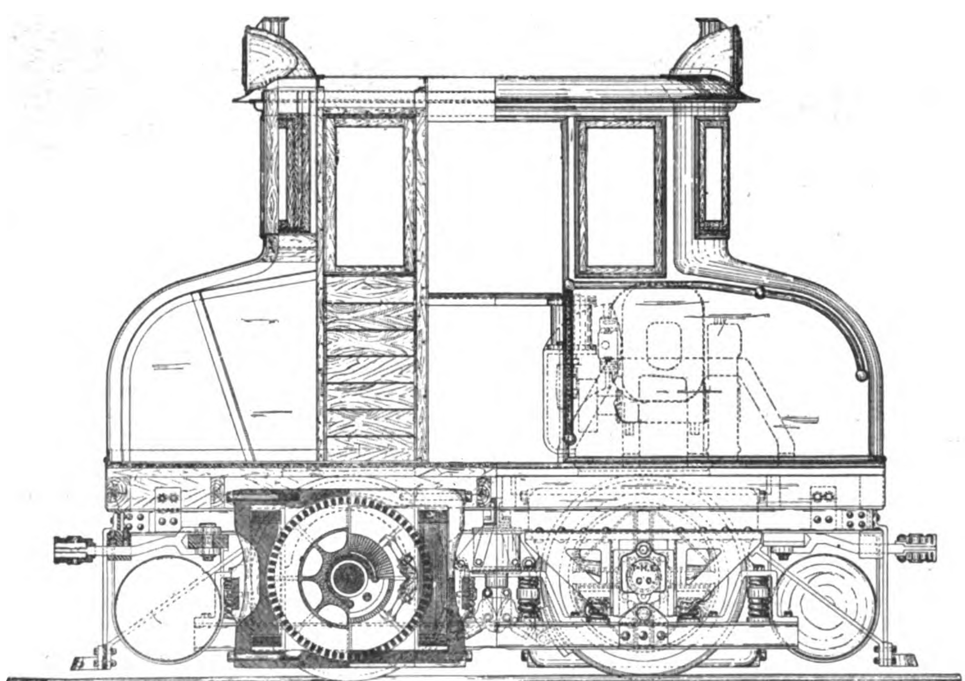


FIG. 3.—30-TON ELECTRIC LOCOMOTIVE, GENERAL ELECTRIC COMPANY.

of the General Electric Company have for some time past been actively engaged preparing plans for locomotives to handle this class of work. As a result of their work, an electric locomotive of this type has recently been completed at the Lynn Works of the General Electric Company and will shortly be exhibited at the World's Fair, Chicago.

It is a 30-ton locomotive designed for a normal speed of 30 miles an hour, and primarily intended for operation on elevated railways, and for passenger and light freight traffic on less important steam roads. It is of compact construction, solidly and substantially built, and runs on four 44-inch wheels. Its dimensions are: 16 feet 6 inches long, 11 feet 6 inches high, 8 feet 4 inches broad, having its drawbars 2 feet 6 inches from top of rail—the Manhattan Elevated Railroad standard height. The drawbar pull is calculated at 6,000 pounds.

The propulsive power is contributed by two electric motors of especial design and construction, each axle being provided with

one motor, as shown in Fig. 1 and 3. The motors are gearless and are supported on spiral springs resting on the side frames of the locomotive truck. This method of suspension leaves the wheels free to adjust themselves to the irregularities of the road-bed, and thus diminish the wear to both tracks and motors.

The motor fields consist of massive iron castings to which the hollow field spools are bolted. The armatures are of the iron-clad type, having each separate winding embedded in a mica-lined slot cut into the curved surface of the laminated iron armature body. The axles of the locomotive pass through the hollow shafts on which the armatures are mounted. These shafts rest in bearings in the motor frame, and are connected to the axles by universal couplings which allow of freedom of motion in all directions. The commutators are of massive construction, and there are four sets of brushes to each commutator.

The motors are controlled by means of a series parallel controller in the interior of the cab. This device embodies all the latest improvements made in this type of apparatus by the General Electric Company. Under test it is found that the series parallel controller allows of a more gradual and easier starting of the electric motor, and the speed can be more delicately and instantaneously controlled than in the case of the steam locomotive.

The truck is suspended from the journal boxes, is constructed of heavy I beams, and forms the foundation for the locomotive cab. This is of sheet iron, of symmetrical design, and so curved off as to diminish the atmospheric resistance as far as possible. The interior is finished in hard wood. Two sliding doors are placed at each side of the cab, and the windows are so arranged as to permit of an unobstructed view in all directions. There is ample space in the cab for the motorman's movements, and it affords him considerably better protection than that usually vouchsafed to the steam locomotive engineer.

The current necessary to the operation of the locomotive will be taken up according to the prevailing conditions. The engraving, Fig. 2 shows an overhead trolley contact, but as conditions change, the means of electrical contact would probably be modified, and, instead of a trolley making overhead contact, a sliding shoe and contact with a third conductor rail, as in the case of the Liverpool Elevated Railroad, or the Intramural Railroad, at the World's Fair, might be adopted. The roof of the cab will carry the necessary head-lights as shown in Fig. 3.

The air for the brakes is supplied by a special electrical air compressor, which also operates the whistles. This air pump, Fig. 4, has an oscillating cylinder of six inches diameter, with a six inch stroke, and will supply 6,000 cu. ins. of air per minute at 70 pounds pressure. The motor is similar to the N. W. P. 2½ in general appearance, but is wound for a higher speed. The field cores are also longer. The normal speed of the armature shaft is 675 revolutions, and of the crank shaft of the pump 110 revolutions. The dimensions of the air compressor are: Length 41 inches, width 16½ inches, height 25 inches. The pump motor is controlled by a special rheostat. This, by an ingenious intermediary device, is automatically regulated by the air pressure.

The locomotive has already been put into actual operation. Fig. 2 shows it drawing a train of freight cars on the regulation steam track. In a trial of strength between it and a steam locomotive of somewhat larger size, it was found that the electric locomotive had the best in this novel tug of war.

The use of these electric motors is, over very long distances, at present only limited by the cost of long lines of electric feeders, and until the problem offered by this condition is solved, restriction of the electric motor's employment must necessarily continue to exist. But for places where traffic is densest, the denser the better, the electric motor is peculiarly fitted, for here all advantages of the electric propulsion are available, unhampered by the expense involved in long feeder lines.

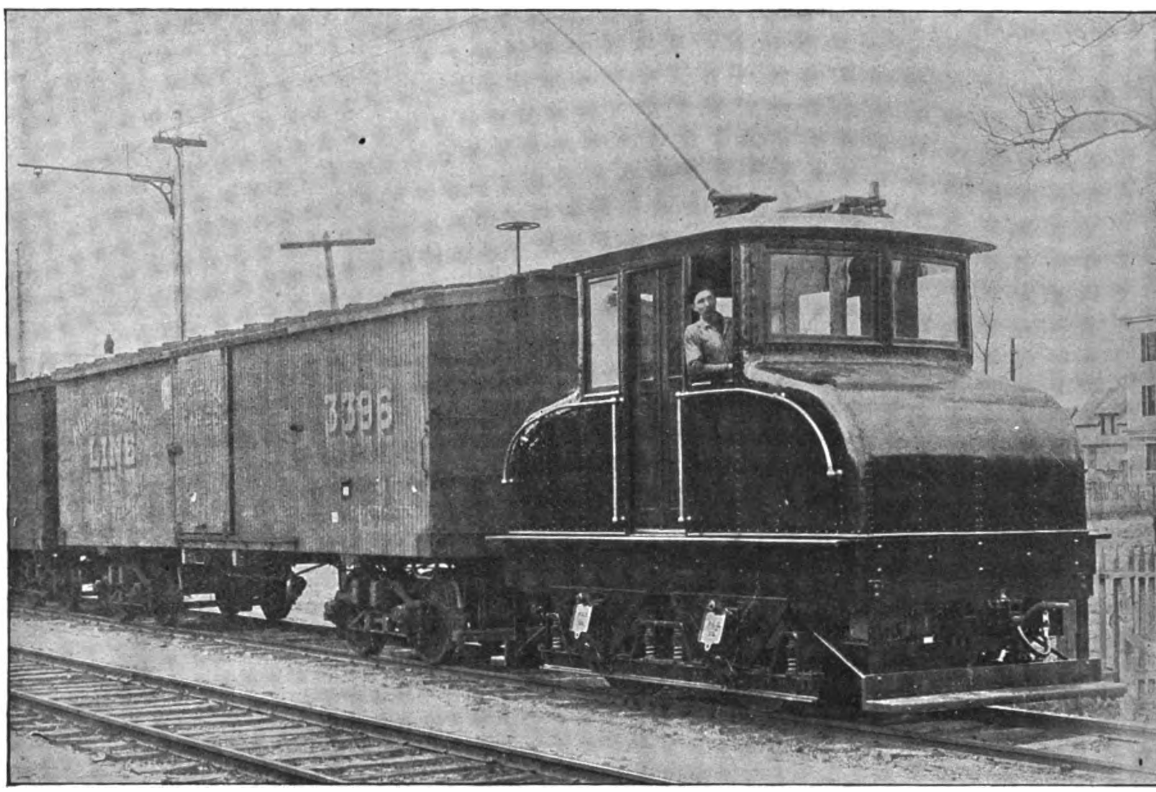


FIG. 2.—30-TON ELECTRIC LOCOMOTIVE, GENERAL ELECTRIC CO.

A NOVEL ELECTRIC TRANSIT SCHEME FOR NAPLES, ITALY.

A NOVEL system of rapid transit has been devised for the city of Naples. At present there is no satisfactory means of transit between the high level and the low level sections of the city, and it is to provide this that the new line is projected. The line is to be carried on two metallic viaducts, each divided so as to form a double way, one for the operation of electric cars and the other for pedestrians. A masonry tower 325 feet high is to be built in the Via Roma, and from this the first viaduct, 1180, feet long, will be carried to the Corso Vittorio Emmanuele, where it will terminate the base of a metallic tower 490 feet in height. The second viaduct, 950 feet long, branching out of this tower some distance below the summit will pass over the San Martino Hill and end in the ground level at the new Rione del Vomero. The viaducts will be carried on pyramidal metallic towers having masonry foundations; and the masonry tower at the beginning of the first viaduct and the metallic tower connecting the two viaducts will each be provided with staircases and capacious elevators for conveying passengers up and down. Passengers entering the cars at either end of the line will not be compelled to change their seats on arriving at the metallic tower, as the cars will be automatically placed on the lifts for ascending to or descending from the highest viaduct, when the cars will continue their way to either terminus. Stations will be provided at each terminus to generate current for lighting and power purposes. A concession has been granted for the road.

KUHLMANN'S COUNTERBALANCE SYSTEM OF OPERATING ELECTRIC CARS ON STEEP GRADES.[1]

It frequently happens in locating an electric street railway line that there will be one or two places where for a short distance the street grades will necessitate a track grade too great to be easily overcome by the ordinary motor power without danger of injury to the mechanism, while the grades on the remainder of

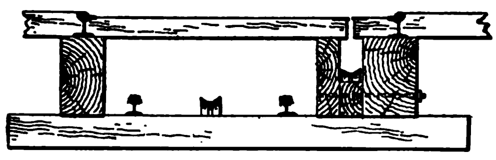


Fig. 1.

the line will be quite easy. At such places a simple device for furnishing additional power to overcome the grades can evidently be used to advantage. The device illustrated herewith is the invention of Mr. J. P. F. Kuhlmann, a civil and mechanical engineer of Seattle, Wash., and is the solution of the problem which confronted him in building the Ranier avenue electric line down the steep hill to the water front on Washington street, in Seattle, Wash. Subsequently it was used with some improvements on the Front street line, of the City and West Portland Park Motor Line, in Portland, Ore.

On the Washington street line the grades between South Fifth street and South Eighth street, for a distance of 1,000 feet, are 11, 14 and 16 per cent., respectively. Evidently the electric cars could not descend these grades safely with nothing more than the ordinary wheel brakes to restrain them, and unusually heavy motors would be needed to surmount them. A cable-road was obviously too expensive for such a short piece of line, so that some economical device had to be found to aid in the ascent and to check the descent. The plan devised was to operate a counterbalance weight running in a conduit underneath the track. This conduit was three feet wide and 18 inches deep, and is shown in section in Fig. 1. In it two weights aggregating six tons run on a track. To one end of these weights is attached a ¾-inch wire rope and to the other a ⅝-inch rope, which runs in a smaller conduit on the inner side of the right hand rail. Upon reaching the top of the grade on its way down the car picks up the dummy rope in the small conduit by being coupled to a bar projecting about 8 inches from the ground, and in descending hauls up the weights, thereby checking its speed so that the wheel brakes will hold it if necessary. A car going up the hill is coupled in the same manner, and by means of the electric power starts the weights from the level at the top, which in descending aid in pulling the car up the grade. When the weights reach the foot of the grade and are released, any shock is avoided by means of a pneumatic buffer composed of 8-inch wrought iron pipes, in which 7-inch pistons work. On starting up the hill the weights pull out the pistons by means of a finger which is released automatically. Similar buffers are situated at the top of the grade. It may be stated that the weights exactly balance an empty car, and the motor has to overcome the weight of the load only.

The line as thus constructed was put in operation on Aug. 28, 1891, and has worked with uniform success since In the Front street line of the City & West Portland Park Motor Co.'s line, in Portland, Ore., however, the system has been improved in many particulars. The details of the mechanism at the upper and lower landings of this line are shown in Fig. 2. This line runs up Front street, for a distance of 550 feet from the Southern Pacific R. R., crossing to Thomas street on a grade of from 12 to 14 per cent., and the need of some device for quickly stopping the cars is enhanced by the fact that the railway crossing is on a curve on a bridge just as the road leaves a side hill cut, making it impossible to see the trains coming.

For this line the main conduit was made the full width of the track, 42 inches wide, and 14 inches deep, with the smaller conduit, 6 inches wide and 8 inches deep, in which the dummy rope runs, directly above it. This arrangement may be seen from the section, Fig. 2. The principal improvement is in the coupling device which is inserted in the guard at the lower end of the car. The car on arriving at the lower end of the grade is stopped about 4 feet above the point where the coupling tongue is located. This tongue, which forms the connection with the cable, is then raised above the slot by a lever located at one side of the track. The car is then allowed to run backward by gravity and to couple itself automatically. The current is then applied starting the car, and, through the tail ropes, the weights at the upper end of the grade. When the car arrives at the upper end, the conductor pulls a cord which disengages the tongue, and it proceeds on its journey without stopping. On the down trip the tongue, which projects from the slot and is protected by a swelling in the roadbed, connects automatically with the car, making it impossible for it to descend the grade without pulling up the weights. At the lower end the conductor steps off the car and by raising the lever disconnects the car from the tongue. This coupling device requires the car to stop but once on the round trip, but it has to slacken speed for all connections and disconnections. On the Seattle line the coupling consists of a forked drawbar, in which the tongue attached to the dummy or the weights is fastened by a pin. This line also has safety brakes connecting the weights which act instantly in case the rope breaks, but these are dispensed with at Portland as unnecessary, and so also are the pneumatic buffers at the upper end, as the connecting tongue is so arranged that the weights cannot move after the car disconnects. The weights on this line are 6¼ tons.

Mr. Kuhlmann states that he has carried as many as 95 passengers at a speed of seven miles an hour on the Portland line, and that twice a day a freight trailer is attached to the motor and is moved with ease. A fuse rarely blows out, and then only when the voltage falls low on account of insufficient feed wires. He is satisfied by experiments that if the counterweight is made 25 per cent. heavier than the empty car, a grade of 20 per cent. may be overcome and 75 passengers carried with the same motors and at the same speed. Two weights are used to follow the change in grades more easily, and when small single-truck cars are run only one need be used, the other being left at the upper end of the grade.

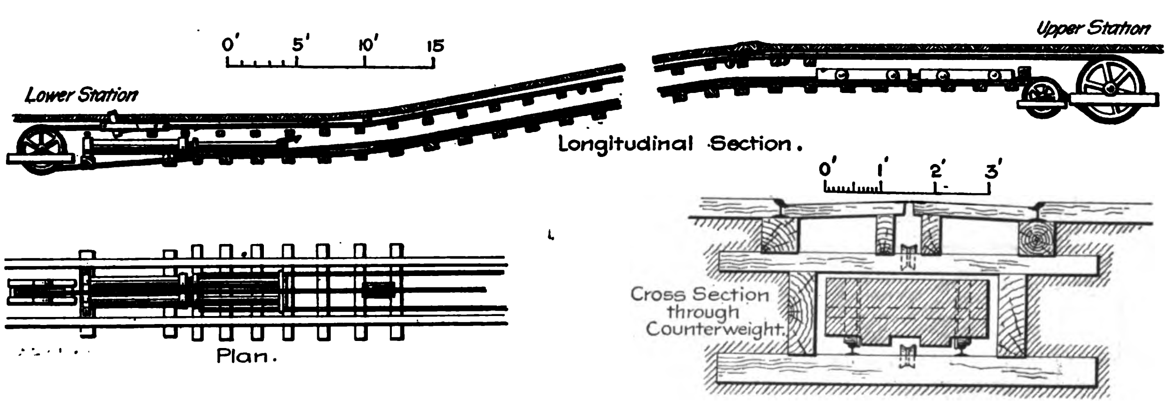


Fig. 2.—Kuhlmann's Counterbalance System of Operating Electric Cars on Steep Grades.

1. *Engineering News*, New York.

ELECTRIC RAILROADING IN MONTREAL.

Mr. A. J. Corriveau, states that the Montreal Park and Island Railway Company will not be consolidated with the Montreal Street Railway, but will be carried on quite independently. Sir Donald Smith is among those interested in it. The company is now rapidly proceeding with the work of construction through St. Louis du Mile End and the first line to be completed will be that to Sault au Recollet, which it hopes to have in operation by the first of September. It will then proceed with the other lines and in a few years hope to have the entire island covered with electric railways in spite of all the opposition.

RATS AND THE TROLLEY.

It it stated that in some parts of Brooklyn there is a plague of rats owing to the exodus of the rodents from the car stables, the trolley having supplanted about 2,100 horses already on the Brooklyn City Railroad, which now has about 400 trolley cars in operation. The rats have therefore deserted the stables for better feeding quarters.

GOOD WORDS FOR THE TROLLEY IN BROOKLYN.

THE apparently large number of accidents with trolley cars in Brooklyn has led some people and a few newspapers there to denounce the trolley as being to blame. But better judgment prevails in some quarters, and the *Standard-Union* may be cited for its common sense treatment of the subject. In a recent editorial it said:

As the trolley becomes familiar the fatalities cease. The drivers become skilled and acquire confidence, that is an element of safety. They also know better and better that carelessness is a crime, and the people are more prudent. In the cities of St. Paul and Minneapolis there is not a horse car left, and there are more than 300 miles of trolleys; and there are marked improvements in speed, certainty, cleanliness, wholesomeness, over the old street car business, and as great safety. Many of the Western cities are studious of these results, and there is enthusiasm in getting rid of the horse cars completely.

Commenting on this, Mr. A. A. Knudson, wrote to the *Standard-Union*, and in the course of his letter he made the following additional points:

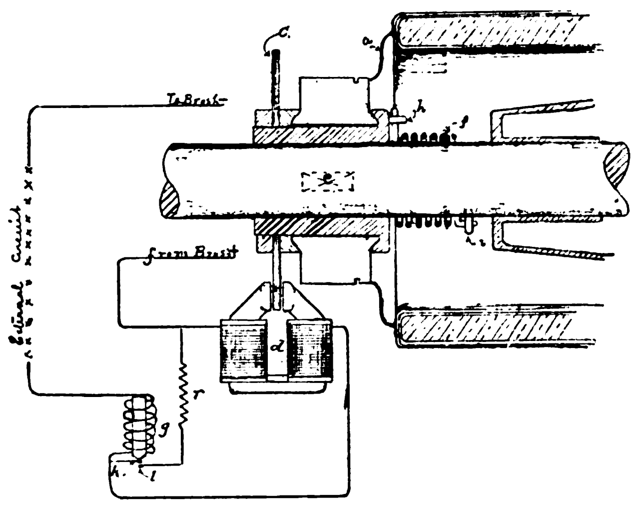
There is also evidence that the companies are moving in the direction of adopting methods for public safety, as I have already seen one trolley car equipped with a safety guard, and no doubt others are being done in the same way. There is one point of advantage in favor of the trolley cars which I do not think the public at large appreciate, and that is on the score of health. The doing away with thousands of horses from our streets; the closing up of large stables besides abolishing the relay stables and tow-horse stands (the two latter maintained in the very heart of the city), especially during the summer months, must naturally have a very important effect, not only upon the increased cleanliness and consequent healthfulness of the city, but also an increase in the value of real estate may be reasonably looked for in the neighborhood where these nuisances, especially relay sheds, formerly were. There are a few left, I believe, such as the one on the corner of Fulton street and Portland avenue, but the few places that know them now will soon know them no more, fortunately for the residents in their vicinity and the general health of the city.

Now, this improved state of things, is being brought about by what some have termed the "deadly trolley." If a committee of physicians were selected to examine this question, and decide, which, in their opinion, was the most deadly, I am quite sure they would report horses, by far, that is, in a general sense.

LETTERS TO THE EDITOR.

HENRY'S METHOD OF REGULATION.

MY attention has been drawn to an article with diagram in the ENGINEER of June 21, entitled "Henry's Regulator for Constant Current Motors." In December, 1891, or Jan., 1892, while with



the Thomson-Houston Electric Co., I submitted to the inspection of your electrical patent expert a sketch of a regulator designed by Mr. Chytraus and myself, which is resembled so closely by the sketch in the ENGINEER that I venture to call your attention to this similarity. Your expert in giving his opinion in a letter to me said, that a patent had been previously issued, covering what we claimed as our invention. Other duties at the time prevented me pushing the matter further and in the meantime that great thief, procrastination, robbed us of what we might have had. I write this with the object of warning youthful inventors to lose no time in patenting any invention they may devise.

Above will be found a sketch and description of our regulator as designed originally, and which bears date, Oct. 19, 1891, and is witnessed by Mr. Alex. Barrie, draughtsman in the Thomson-Houston works, at Lynn. The point of difference between Mr. Henry's regulator and ours lies just here: While in his the brush yoke is movable, in ours it is fixed, while the commutator is free to move on the shaft in opposition to a spiral spring.

Referring to the accompanying diagram, on the end of the commutator is fastened a disc *c* of copper which revolves between the poles of an electromagnet *d* in series or shunt, with the external circuit, according as the regulator is used on constant current generator or motor. A spring *f* is coiled right-handedly on the shaft and fastened to the commutator at *h* and to the shaft at *i*. A pin *e* in the shaft prevents the commutator moving through more than a certain angle while to admit of this movement of the commutator on the shaft, flexible connections *a* are used between the armature and commutator.

The regulating magnet *d* is thrown in or out of circuit by means of a solenoid *g*. As the current strengthens, the circuit at the points *l* and *k* is opened, allowing the current to enter *d* and to shift the commutator to a weaker position in the field. *r* is a resistance thrown in to lessen the spark when the circuit is opened at *l* and *k*.

A CONSTANT READER.

TORONTO, CANADA, June 25, 1893.

Our correspondent appears to be in error in some of the statements contained in the above letter. THE ELECTRICAL ENGINEER has never had a patent bureau and hence never required the services of a patent expert.—EDS. E. E.

THE OPERATION OF THE MOVING SIDEWALK.

Will you kindly answer in the ENGINEER the following question in regard to the moving sidewalk at the World's Fair? From your description of this work I understand that the inner or faster platform is supported by parallel, endless rails which rest on the periphery of the truck wheels. Now during the straight part of the walk these rails must, of course, have equal linear speeds, but at either end, around the curve, the outer rail would tend to go faster than the inner. It would seem as though this tendency of one *endless* rail, to have different rates of motion in different sections at the same time, would produce serious complications, and if you will explain how the constructors of the sidewalk have arranged for this difficulty you will confer a favor on several of your readers who have become interested in the question.

JUNE 27, 1893. C.

The inquiry of our correspondent was submitted to Mr. Max E. Schmidt, vice-president of the Pier Movable Sidewalk Company, who has favored us with the following reply:

The difficulty which "C." mentions in providing for the differential rates of speed of the two flexible rails, we were well aware of before starting, and we quite expected to have serious trouble before we would find out how to assist the sliding of the flexible rail on the wheel when going from a tangent into a curve and from one curve into another at the point where they reverse. We have, however, had no difficulty whatever except at the first start which we made and when there was a slight tendency of the flexible rail to buckle at this point. By simply applying a greased cloth to the bottom of the flexible rail, this tendency is entirely overcome, and although our curves are extremely sharp, the motion of the flexible rails is under perfect adjustment at all times. When it is remembered that we have 696 degrees of curvature in 4,800 feet length of track and that the radius of the largest curve is 80 feet, and of the sharpest, 64 feet and 9 inches I think that our success in the exact direction which is pointed out by "C." is indeed gratifying.

ELECTRIC LIGHT EARNINGS IN NEW JERSEY.

THE report of the State Board of Assessors for 1892 contains a very interesting table concerning the gas and electric light companies of this State. The companies are taxed on gross receipts, and in addition, on all the dividends in excess of four per cent. The schedule gives the gross receipts, the dividends in excess of four per cent, and the tax, The Dover Electric Light Company reports gross receipts at $10,032.96, and no dividends, The Essex County Electric Light Company reports the gross receipts at $41,336.83; dividends, $2,392, and the total tax is $326.78. The Excelsior Electric Light Company reports gross receipts at $22,161.34, and no dividends. The Hudson Electric Light Company reports gross receipts at $63,299.12; no dividends. The Jersey City Electric Light Company reports the gross receipts at $62,528 66; no dividends. It is taxed at $312.64. The Newark Electric Light and Power Company reports gross receipts at $209,897.90 on which a tax of $1,049.49 is imposed. The dividends in excess of four per cent. are reported at $9,500, on which a tax of $475 is imposed. The total tax is $1,524.49.

TO LIMIT COPPER PRODUCTION.

THE *Financial News*, of London, says that the representatives of American and European producers of copper, with the exception of the agent of one small American group have agreed to renew the compact which expired June 30, restricting the output of the metal. According to the terms of this compact, the American producers undertook to limit the exports of copper from the United States to 40,000 tons a year. The American exports of the metal during the past year actually amounted to 37,000 tons.

CONCENTRIC CABLE PHENOMENA IN ALTERNATE CURRENT WORKING.

BY

L. Neustadt

It was noticed in a large network of concentric cables traversed by an alternating high-pressure current, that the insulation was often destroyed when a section of cable was switched in or cut

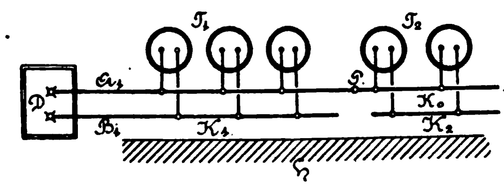


Fig. 1.

out during the working, or if a cable fuse went. In most cases the damage was done to the insulation between the outer conductor of the cable and the sheath, which is, of course, generally somewhat thinner than that between the two conductors. This phenomenon, which was frequently observed in a large network embracing about 85 kilometres, occurred also in such cables as not only left nothing to be desired as far as insulation was concerned, but in which the insulation had been experimentally tested before laying with a pressure many times the normal working voltage, without sustaining injury of any kind whatever. The puncture only occurred when the inner conductor was coupled first (in the case of a joint being effected), or conversely if the outer conductor was first disconnected, and when the section in question contained transformers, which had either open or very lightly loaded secondary circuits. The cause of this phenomenon, which may have very serious effect on working, is the subject of the following remarks.

In Fig. 1 let D be the generator, delivering an alternating current into the cable, of which A is the inner and B the outer conductor, and let T represent transformers and K the condenser formed by the outer conductor B and the sheath H of the cable, which is, of course, earthed. Let K_0 be the condenser which is formed by the inner and outer conductors of the cable. The point of junction of the two parts of the inner conductor A is at P. Indices (1) indicate the parts of the system coupled to the dynamo, and indices (2) apply to the parts connected only by the inner conductor at P to the system. In this investigation I shall suppose that the insulation of the cable network is perfect, and that there are no concentric cables in the secondary network.

One circuit is formed by the dynamo D, the conductor A_1 B_1, and the primary of the transformer T_1; another circuit, the one with which we are concerned, and which is diagramatically shown in Fig. 2, is formed by the dynamo T, the conductors A_1 A_2 and B_2, the transformers (with little or no load on) T_2, the condensers K_0 K_1 K_2, and the outer sheath H (earth). Call the voltage at the terminals of the dynamo E, and assume that E may be expressed by the simple formula,

$$E = \sqrt{\frac{r}{2}\int_0^{\frac{2}{p}} (E_0 \sin p\,\pi\,t)^2\,dt.}$$

and neglect any drop of volts which may take place in the cable itself. Let I be the current in the circuit we are examining, L

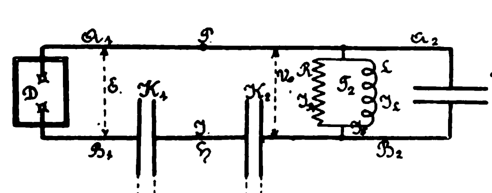


Fig. 2.

the coefficient of the self-induction of the transformer system T_2; let R be a resistance which represents the equivalent of the losses by hysteresis, eddy currents and load in the transformers, according to the formula

$$W = V_0{}^2/R,$$

and V_0 represent the pressure at the transformers.[1] The phenomena are easily explainable if we assume that K_1 is very great compared with K_2, and K_0 is very small compared with K_2, and that we are dealing with an ideally good, unloaded transformer, so that

$$R = a, \qquad K_1 = a, \qquad K_0 = 0.$$

This assumption leads to the case shown in Fig. 3, under which circumstances it is well known that in certain cases the voltage at L and K_2 may be many times higher than that at the terminals of the machine.

Returning to Fig. 2, suppose for the sake of further investigation that V_0 represents the pressure at the group of transformers T_2—that is to say, the voltage between the conductors of the cable; and that V_2 represents the voltage at the condenser K_2—that is to say, the pressure between the outer conductor and the sheath or earth. For I_1, V_0, and V_2 values can be found in terms of E under the foregoing assumptions, which I write down as the result of somewhat tedious though easy calculations, without trying the patience of readers with the full working of formulæ which rest on assumption which are not entirely justifiable.

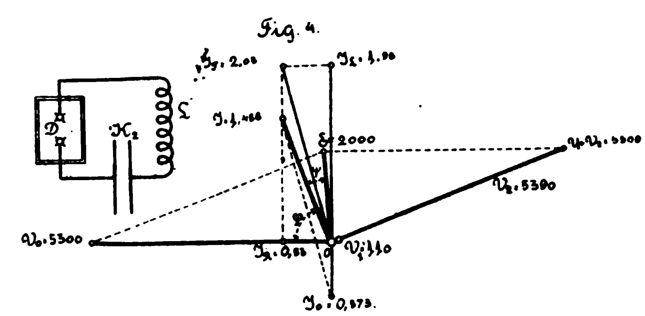
$$I = E \times \frac{p.\pi.K_1K_2}{K_1+K_2}\sqrt{\frac{\left(\frac{1}{R}\right)^2+\left(\frac{1}{p\,\pi\,L}-p\,\pi\,K_0\right)^2}{\left(\frac{1}{R}\right)^2+\left\{\frac{1}{p\,\pi\,L}-p\,\pi\left(\frac{K_1\,K_2}{K_1+K_2}+K_0\right)\right\}^2}}.$$

$$V_0 = E \times \frac{K_1}{K_1+K_2}\sqrt{\frac{(p\,.\,\pi\,.\,K_2)^2}{\left(\frac{1}{R}\right)^2+\left\{\frac{1}{p\,\pi\,L}-p\,\pi\left(\frac{K_1\,K_2}{K_1+K_2}+K_0\right)\right\}^2}}$$

$$V_2 = E \times \frac{K_1}{K_1+K_2}\sqrt{\frac{\left(\frac{1}{R}\right)^2+\left(\frac{1}{p\,\pi\,L}-p\,\pi\,K_0\right)^2}{\left(\frac{1}{R}\right)^2+\left\{\frac{1}{p.\,\pi.\,L}-p\,\pi\left(\frac{K_1\,K_2}{K_1+K_2}+K_0\right)\right\}^2}}.$$

I will not enter into a general discussion of these equations, but will consider a particular case numerically, taking values in practical use as a starting point which apply to the diagram constructed for the purpose. I observe further that the relation of L to R and of K_0 to K_2 is given by the general design of the transformer and cables used; while the relation of K_1 to K_2 depends on the lengths for the particular case and other dimensions of the network.

For example, let the frequency be 43 ∼, then $p\,\pi = 270$; and let $E = 2{,}000$ volts, $R = 10{,}000$ ohms, $L = 10 \times 10^9$ C. G. S. units, $K_1 = 50$ microfarads, $K_2 = 1.0$ microfarad, $K_0 = 0.4$ microfarad.



Figs. 3 and 4.

These values represent a network of a total length of about 85 kilometres of between 25 and 250 square millimetres cross section, to which network is coupled a section of cable ½ kilometre long containing transformers of about 20 kilowatts output, with no secondary load. Fig. 4 gives the diagram of the voltages and currents which can be constructed on the above assumptions, and which represents the formulæ given above.

The current circulating in the resistance R (I_a) is in the same phase as V_0, and the current (I_1) representing the self-induction is 90 degrees behind V_0; the current through the condenser K_0 (I_0) is 90 degrees ahead of V_0. The total current I is the resultant of I_a I_L and I_0, displaced from V_0 by an angle φ. The voltages V_1 and V_2 are 90 degrees behind the current I; and the resultant E. M. F. E, resulting from the combination of V_0 V_1 V_2 is displaced by an angle ψ differing in phase from the resultant current I. Looking at Fig. 4 we see that $V_0 \cos\varphi = E \cos\psi$, whence we note that the greater the angle φ (that is, the greater the displacement of phase in the system T_2 K_0, and the smaller the angle ψ, the greater can V_0 and $(V_1 + V_2)$ become relatively to E—that is to say, the greater can the pressure become on the insulating material of the cable for the same voltage on the dynamo. The

1. R is really not a constant quantity, as the energy used for magnetizing and demagnetizing the transformers cannot be put proportional to the square of the volts V_0.

pressure $V_1 + V_2$ divides itself in the inverse ratio of the capacities K_1, K_2 on the two condensers, that is to say, the higher and dangerous pressure comes on that piece of cable which has the smaller capacity; in most cases, therefore, on the part of the network which is being switched in or out. The greater K_1 becomes in relation to K_2, the greater becomes V_2 in relation to V_1, but when K_1 becomes much larger than K_2, the ratio V_2/V_1 rises very slowly, even if K_1 becomes very much larger. Thus when the section of the network already working is very extensive, the addition of another portion becomes of less importance and has less effect. For a certain length of the cable switched in (K_0, K_2) there is a certain number of transformers ($R\,L$), for which the ratios $V_0 : E$ and $V_1 + V_2 : E$ become maxima.

The calculations I have taken as an example under the above assumptions gave for V_0 and V_2 pressures of 5,800 and 5,890 volts, with a generator supplying current at 2,000 volts; and on the assumption that the dynamo furnished currents and volts which followed substantiallly a sine law. These cases are not very common in practical dynamos; on the other hand, there are cases in which the departure from a sine law is so great that a relatively much higher rise of volts can take place than in the case just considered. Further, a rise of volts can also take place for this reason, that the iron cores of the transformers become more saturated on account of the rise in volts. Apart from these later considerations the "theoretical" values of V_0 and V_2 represent by themselves pressures which would be a source of danger to the cable network and the transformers coupled to it, and which as experience has shown are large enough to be a source of breakdown in cases in which the factors happen to have the right ratio to one another.

To avoid this undesirable rise of volts a rule must be made that the inner conductor must never remain coupled on alone in cases where the switching arrangements are not so constructed as to make a mistake impossible.

TEST OF THE FORD-WASHBURN STORAGE BATTERY.

We have received from the Ford-Washburn Storelectro Co., of Cleveland, a copy of a most interesting report made upon their storage battery by Prof. John W. Langley, professor of electrical engineering, and Prof. Chas. F. Mabery, professor of chemistry, at the Case School of Science, Cleveland, O.

Each of the four cells upon which the principal tests were made consisted of a glass jar with five elements, with a total weight of 70 pounds. The lead elements weighed 42 pounds and the electrolyte in which they were immersed consisted of dilute sulphuric acid with a specific gravity of 18 degrees C. or 1.155, and it contained 1.49 per cent. by weight of sodium sulphate. All these cells were constructed according to the regular Ford-Washburn plan which includes a flat bar of lead for the positive pole, placed within a perforated conductor of sheet lead which is filled with lead dioxide. This lead conductor is placed with a porous earthenware cell with the following dimensions: Width, 4½ inches, breadth, ¾ inches, thickness of wall, ⅛ to $\frac{3}{16}$ inches. The space between the internal lead conductor and the porous cell is filled with lead dioxide. This earthenware cell is placed within another perforated sheet lead conductor, and the space between the outside surface of the earthenware cell and the external lead conductor is filled with litharge. These two lead conductors with the porous earthenware cell constitute a single element, and five of these elements compose a complete cell. The positive conductors are connected together in multiple to form the positive pole of the cell, and the negative conductors in the same manner to form the negative pole of the cell. The external dimensions of each element are: Width 5 inches, breadth 1¼ inches, height 10 inches. The complete cell has the following dimensions: Width 6⅝ inches, breadth 8½ inches, height 12⅜ inches.

The four glass cells were discharged in series through a resistance and allowed to run out nearly completely. They gave a total of 150 ampere hours. The discharge curves showed that when the cells were fully charged and then allowed to discharge with constant currents till the voltage had dropped to 1, the total available ampere hours between 2 volts and 1 volt were:

For 10	ampere	rate,	13.25	hours...........	133	ampere hours.
" 15	"	"	8.2	"	123	" "
" 20	"	"	5.	"	100	" "
" 30	"	"	3.	"	90.5	" "

The internal resistance of the cells remained practically unchanged after two months' constant use of the cells.

Exhaustive tests for efficiency and mechanical properties such as ability to stand severe vibration were also undertaken, which are given in the summary appended to the report of Profs. Langley and Mabery as follows:

1. The cells have not appreciably changed their internal resistance during two months' constant use, when tested under similar conditions.

2. Vibration and shaking continued for an aggregate of 422 hours, did not increase the internal resistance.

3. The ampere capacity of the cells is 150 hours when tested to exhaustion, and when drawn down to one volt a cell holds 133 ampere hours at a ten ampere rate of discharge.

4. The practical working limits of voltage are from two volts to one volt.

5. The cells do not show any marked tendency to "sulphating" and their internal resistance is not permanently raised thereby.

6. During the interval covered by this report, neither large rates of charging and discharging nor a prolonged course of vibration imitating that of a street car, produced any measurable deterioration of plates. In this respect the Ford-Washburn cell was in marked contrast to a cell of the grid type used for comparison.

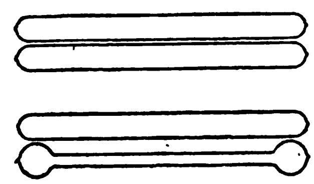
7. The ampere efficiency varied from 78 to 86 per cent., and the energy efficiency from 55 to 72 per cent.

8. The electrical and mechanical hard treatment to which the cells have been subjected in our hands has been excessive, and indicates that they have the qualities to withstand rough usage in practice, for from the results given above it is apparent that no measurable impairment of them was developed by exceptionally severe electrical and mechanical usage during two months, therefore, the point when the life of the cells would be terminated is indefinitely distant in the future.

MUTUAL ATTRACTION OF VACUUM TUBES.[1]

When trying some of the experiments shown at the Royal Society *soirée* by Mr. Pike and myself, I accidentally found that the attraction between two vacuum tubes far exceeded what theory would expect if due only to static effects, or to the mutual action of one current upon another.

Since that night I have been examining this question further. I have here only a limited supply of apparatus, so that my observations are of a general character, and not so comolete as I hope to make them on my return to the country. To sum up the



Figs. 1 and 2.

Fig. 3.

phenomena, which I maintain are truly magnetic, they are:

1. Two vacuum tubes attract one another strongly.

2. The attraction is almost, if not quite, the same, whether they touch one another along the whole length, as in Fig. 1, or only at their ends, as in Fig. 2.

The upper tube in these experiments had the current induced in it by the lower tube.

3. A spiral vacuum tube sucks in a "core" tube like a solenoid does an iron core, and the more the "core" is drawn in the less luminous the "core" tube appears. This lessening of luminosity might be expected. The core tube was not connected to the circuit.

4. When the tubes are placed end to end, as in Fig. 3, they attract one another and stick together; no repulsion takes place, which should occur if the effect were of a "static" nature. One tube *induced*.

5. No. 4 effect remains the same, no matter what positions are given to the tubes.

6. There are many other phenomena requiring further investigations; I, therefore will not give incomplete and doubtful results.

I believe this subject is new, and if known already to anyone it has not come to light. Being a "bad hand" at producing papers, for want of time, and perhaps capacity in this respect, leads me to write these few lines in the interest of workers in the same direction.

THERMO-ELECTRICITY.

At his recent lecture at the Royal Institute, Prof. Dewar gave an interesting proof of the accuracy of the Thomson and Tait thermo-electric diagram. The lines of platinum and copper, if produced in the direction of cooling, are found to meet at a temperature of —95° C. For palladium and copper, the point of intersection is —170° C. If the diagram fairly represents the E. M. F.'s of the junctions, it is clear that at the points of intersection the E. M. F.'s should pass through zero and then reverse. With the very low temperatures attainable with oxygen vapor, it is possible to verify these assumptions. With Cu-Pt junction connected to a galvanometer, the spot of light was observed to fall to zero at —100° C., and then to reverse. With a Cu-Pd junction, the same effect occurred at about —170° C.

1. Sir David Salomons in London *Electrician*.

AN IDEAL ISOLATED ELECTRIC LIGHT PLANT—SOCIETY FOR SAVINGS BUILDING, CLEVELAND.

The isolated plant recently installed for the lighting of the Society for Savings Building in Cleveland, Ohio, a cut of which building appears in vignette at the beginning of this article, is a striking example of the combination of the æsthetic and the practical.

Since the completion of the building in 1890, it has been lighted from the station of the Cleveland Electric Light Company, its next door neighbor, but for numerous reasons it became desirable to have a plant of its own, and the contract for the same was awarded to Messrs. Barr & Houghton, the local agents for the General Electric Company.

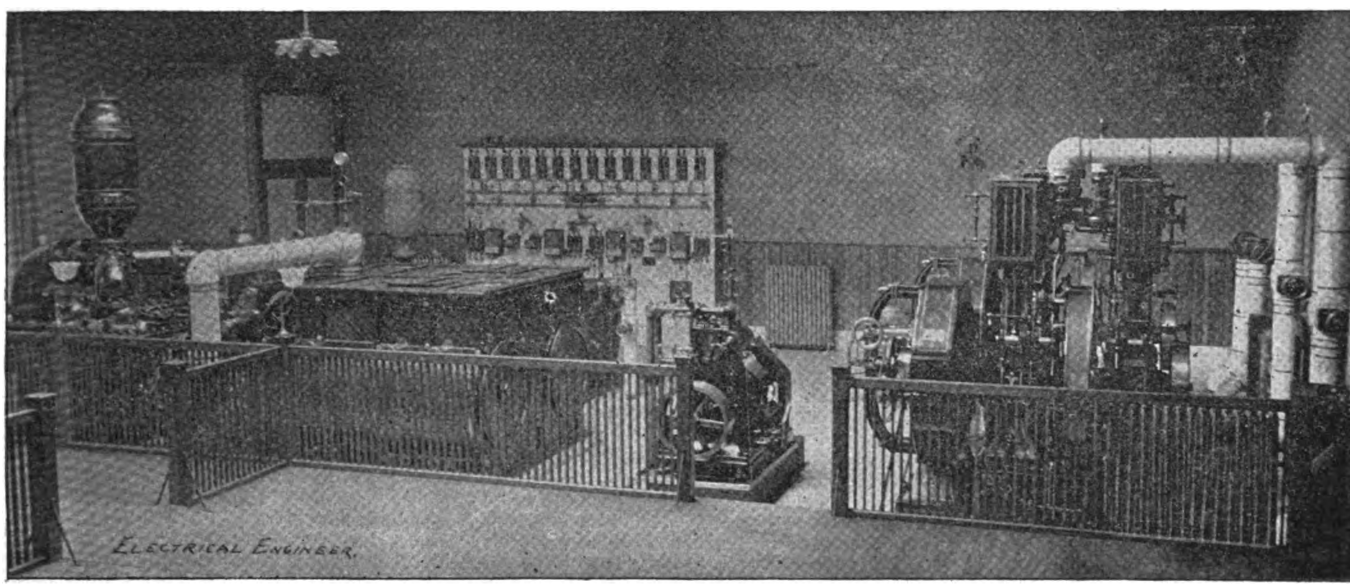
A handsome one story building about 50 feet square and 20 feet high, built of brick, tile and iron was erected in the rear of the large structure, with excavation for boilers, heaters, etc.

The wires from the machines pass beneath the floor to the switchboard, which is a beautiful piece of work built up of a number of slabs of fine Italian marble, all connections being made upon the back, thus leaving the face free for the necessary instruments, etc.

All bus bars, links and switches are highly polished and lacquered, giving to the whole a most finished appearance.

Besides the electric plant there are also placed in the same room two pumps used in connection with the building's elevators. The large pump is of the Gordon manufacture, with steam pressure of 80 pounds, and at 50 strokes per minute, and designed to deliver 1,150 gallons against a pressure of 100 pounds. This pump is of itself of sufficient capacity to meet the maximum demand of the elevators, but we find not only here, but also with boilers, engines and dynamos, etc., that a liberal management has provided a duplicate system throughout. Several things not shown in the engraving are worthy of notice, such as the board containing a symmetrical arrangement of the steam and water gauges; also the little machine shop in one corner and in another corner the private office of the Society's able and courteous engineer, Mr. M. B. Sturtevant.

The installation of the electrical apparatus was made under the supervision of Mr. H. H. Holding, of the General Electric Company's Cincinnati office and Mr. W. H. Morton from Schenectady, both of whom deserve great credit for the general excellence of the construction. The plant is almost an exact realization of what was described by Mr. C. J. Field in a recent article in THE ELECTRICAL ENGINEER as an ideal plant; but which, he said, would seldom be found in practice owing to that most important item—expense. With such progressive men, however, as Samuel H. Mather and Col. Myron F. Herrick, two of the most active spirits of the Society for Savings' management, the question is not "how much" but "how good," and the proof of this statement is furnished by an inspection of the Society's property in general and of the electric plant in particular.



ELECTRIC LIGHTING PLANT IN THE SOCIETY FOR SAVINGS BUILDING, CLEVELAND, O.

The dynamo plant, which is shown in the accompanying engraving, at present consists of two 25 K. W. machines, direct connected to two engines of the Lake Erie Engineering Company, of Buffalo, N. Y., and of one 15 K. W., also direct connected to a Case engine, the engine and dynamo forming what is known as the "Case combination." The plant also contains a fourth dynamo of 50 K. W. capacity coupled also to a Lake Erie engine. No trouble whatever is experienced in running any two or more of these dynamos together, and with this fact before us, it requires but a few strokes of the pencil to discover the great flexibility of a plant equipped as this one is with such a variety of independent units. No less than nine combinations are to be obtained; from which we would anticipate a very economical handling of the variable load.

The 25 K. W. machines are of a new pattern, known as the "D. D" type, compound wound, having a Gramme ring armature, keyed to the crank shaft, and the armature being overhung and revolving at a speed of 300 revolutions per minute. The yoke shown in the engraving is simply a support of the socket arm, which latter is moved by a hand wheel. Each dynamo has its shunt box connected across the series terminals, and used for varying the current through these coils, thereby producing the desired voltage. The overhanging of the armature appears at first as rather strange, but we find its analogue in marine practice, in the same method of supporting the screw propeller. In this connection, it might be interesting to state that the weight of the armature of the large generator forming a part of the exhibit of the General Electric Company at the World's Fair, will be about 57,000 pounds and that it is also overhung.

H. M. W.

ELECTRIC CRANES FOR PITTSBURGH.

THE ROBINSON-REA MANUFACTURING COMPANY, Pittsburgh, will equip their new foundry, with two large electric traveling cranes built by Wm. Sellers & Co., Incorporated, of Philadelphia. Each of these cranes has a span of 80 feet, one being of 80 tons capacity and the other 80 tons. The cranes are provided with a double trolley, a distinctive feature which enables the cranes to be engaged on two separate pieces of work at the same time, or both trolleys can be used together, an excellent feature where heavy work is done.

ELECTRO-THERAPEUTICS AT THE WORLD'S FAIR.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION will hold its third annual meeting in Chicago, in Apollo Hall, on September 12, 13 and 14. Dr. A. H. Goelet is president and Miss Margaret A. Cleaves, M. D., secretary.

PERSONAL.

MR. EDWARD R. KNOWLES, C. E., E. E.

Edward R. Knowles, C. E., E. E.

THERE are two general types of inventors, having characteristics which are peculiar to each, and which are seldom found combined in one person. The first type originates new ideas and conceptions, but seldom has the practical ability necessary to render them operative and commercially successful. The other type, while rarely original in its ideas and conceptions, has the practical ability and mechanical skill to devise means whereby the original ideas and conceptions of the first type may be rendered operative and commercially successful. This latter class is made up of the most successful inventors of the day, men of energy and keen perception, quick to see the value of ideas and fertile in expedients for bringing such as are valuable to a successful issue. To this class the subject of this sketch, Mr. Edward R. Knowles, belongs, and while he is perhaps not yet one of the most prominent and widely known inventors and electrical engineers of the present day, he is nevertheless a good example of the gradual but certain success which is sure to attend upon integrity of principle, oneness of purpose and persistency, coupled with marked mechanical and electrical ability.

Mr. Knowles was born in California and at an early period in his life his parents removed to Brooklyn, N. Y., where until quite recently he has always resided. He was educated as a civil engineer at the Brooklyn Polytechnic Institute. After leaving school he served as an assistant engineer on the construction of the great storage reservoir at Hempstead, L. I., until its completion in 1876. He then served as an assistant engineer on the East River Suspension Bridge until 1880. About this time he met the late William E. Sawyer and then first turned his attention seriously to the subject of electrical engineering, which profession he subsequently entered as his calling, resigning his position on the East River Bridge to assume the position of assistant electrician of the Eastern Electric Manufacturing Co., who were then the owners of the now famous Sawyer-Man electric light patents, and for whom William E. Sawyer was the inventor and chief electrician. Mr. Knowles served this company until about the time of the death of William E. Sawyer, when it ceased active operations. He then assumed the position of chief electrician of the American Electric Light Co., from which by combination with the Eastern Electric Manufacturing Co., in 1882, the present Consolidated Electric Light Co. was formed and subsequently the Sawyer-Man Illuminating Co. He remained with the Consolidated Electric Co., in the capacity of chief electrician until 1885, devising and developing the incandescent lamp and system of lighting which bore their name. Resigning his position in this company he was next connected with the Brooklyn Electric Construction Co., devising and developing for them a system of arc lighting. He was next connected with the Mutual Electric Manufacturing Co. and the Mutual Accumulator Co., which last company manufactured the Julien storage battery and for whom he put into operation a complete system of central station lighting by means of storage batteries.

The litigation between the Julien and American Accumulator Companies having been decided in favor of the latter, the Mutual Accumulator Company was forced to suspend operations, and Mr. Knowles then in association with Mr. Ernest C. Webb, a patent attorney, opened an office at 181 Broadway, N. Y., where he practiced successfully as a professional expert in all branches of electrical, civil and mechanical engineering, until the summer of 1891, when he accepted a position with the Schuyler Electric Company, of Middletown, Conn., for which he is now the chief electrician.

It will be noted that Mr. Knowles' electrical work has been largely that of developing, perfecting and rendering commercially successful the varied more or less unfinished and unsuccessful ideas and conceptions of others. At the same time he must be given credit for a vast amount of original work, to which witness is borne by the files of the United States Patent Office. His early association with one of the pioneers in the incandescent lighting field gave him an experience that is hardly equaled in that special department, but of late years he has paid his attention chiefly to arc lighting work on new lines. Last year, THE ELECTRICAL ENGINEER illustrated his new search lights which have been so largely adopted for the U. S. Navy, and have been used on Mount Washington; while a few weeks ago a description was given of the special arc lighting apparatus and general system devised by him for the beautiful Stieringer electric fountains at the World's Fair. Genius has been said to consist in a capacity for taking infinite pains with one's work. Mr. Knowles has a capacity that is simply boundless for taking pains with his work.

LEGAL NOTES.

THE OCONTO LAMP CASE AT MILWAUKEE.

AT Milwaukee, before Judge Seaman in the United States Circuit Court, the litigation of the Edison Electric Light Co. against the Electric Manufacturing Co., of Oconto, Wis., was carried on last week. The complainant asking for a permanent injunction on the ground of infringement. The Oconto Company was represented by Witter & Kenyon of New York and W. H. Webster of Oconto. The Edison Company was represented by F. P. Fish, of Boston, R. W. Dyer and C. E. Mitchell of New York; W. G. Beale of Chicago, and H. G. Underwood of Milwaukee. The case is practially a continuation or rehearing of the Goebel defence, as the Oconto Company relies upon it, with some slight amplification, while the complainant emphasises more strongly than ever the charge of fraud and endeavors to prove it, asserting that the famous lamps in evidence are of quite recent date and not thirty or forty years old as the Goebel story, told long ago in THE ELECTRICAL ENGINEER would show them to be.

It will be remembered that in Boston, Judge Colt decided adversely to the Goebel claims, in the Beacon case, but that in St. Louis, Judge Hallett decided in favor of the Columbia Company, on the same evidence more fully presented.

We are in receipt of telegraphic advices up to the time of our going to press that the court in Milwaukee had arrived at no decision on the affidavits and arguments there offered.

BELL TELEPHONE LITIGATION IN CHICAGO.

A SPECIAL dispatch from Chicago of June 30 says:

The Bell Telephone Company has begun its expected fight to protect its unexpired patents, and the issue was made to-day in suits in the United States Court against two recently established Chicago firms for infringement of patents. The companies referred to are William Hubbard & Co. and the Cushman Telephone Company. In the bill of complaint it is stated that the defendants since March 7, 1893, have been unlawfully making and furnishing for use telephones which embody the inventions still controlled under the patents not yet expired by the American Bell Telephone Company, and that the defendants offer their instruments at rates greatly reduced from those which have heretofore been charged by the Bell Company. Rates being too low for competition, the Bell business has been greatly injured, it is averred. The court is asked to grant a perpetual order of restraint, to prevent the defendants manufacturing the apparatus now turned out, or in any other way infringing on Bell patents.

"INFRINGING" LAMPS BARRED OUT OF NEW YORK.

JUDGE LACOMBE of the United States Circuit Court, has granted injunctions to the Edison Electric Illuminating Co., of New York, against the Holland House and the Hotel Imperial, prohibiting them from using incandescent lamps infringing the Edison patent, under which the Edison Electric Illuminating Co. is sole licensee in the city of New York. The injunction has been suspended in its operation a short time to enable the hotels in question to obtain other means of illumination.

These cases were the first that have been brought here against *users* of the Edison lamp patent as distinguished from *manufacturers*, and the decision seems far reaching in its effects. It is of great importance especially in view of the recent refusal of an injunction by Judge Hallett in St. Louis against a Western manufacturer. The decision will, it is said, be regarded as a rule for all users of other than Edison lamps in the States constituting the Second Circuit, and other suits will be immediately brought against other users similarly situated.

THE USE OF MESSAGE BLANKS.

THE South Dakota State Supreme Court has decided that the Western Union Telegraph Company must accept messages tendered whether or not written upon the regular telegraph blanks. The plaintiff, Joseph Kirby, of Sioux Falls, gets $50 damages under this decision. He has pending 40 other cases.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

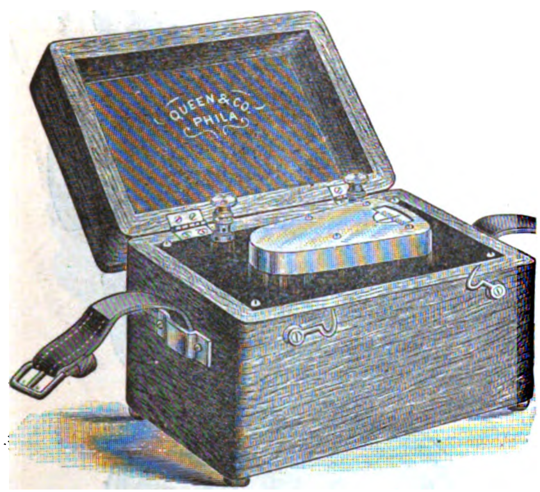
130,000 H. P. OF IDE AND IDEAL ENGINES.

WE have received a circular nearly 120 inches long giving a list of Ide and Ideal engines sold up to March, 1893, and making a grand total of no less than 130,000 h. p. It is a remarkable list, and enumerates purchasers all over the world. Electric light, railway and power plants figure very conspicuously and make a most respectable aggregate, The Memphis, Tenn., electric road for instance, has 1,500 h. p. Altogether the list is one that any manufacturer might well feel proud of. On the back of the list are a number of neat little notes about features of merit in these engines.

THE QUEEN PORTABLE D'ARSONVAL GALVANOMETER.

IN completing a line of portable testing instruments, Queen & Co., Philadelphia, have placed on the market a d'Arsonval galvanometer here illustrated. It is of the type used heretofore in their testing sets and is admirably adapted to laboratory or station measurements and for use as a detector of faults in line wire. The index is quite dead-beat, so that rapid readings are possible, and because of the principle of construction employed, magnetic fields and mechanical vibrations produce practically no effect. As the galvanometer is a "zero" instrument, readings cannot be made by direct deflection, but to determine resistance a rheostat and bridge are necessary exactly as in regular testing sets.

For manufacturing companies, especially where quick work is an item, the meter will prove of much value. It is well suited for ascertaining the resistance of carbon filaments for incandescent lamps, and has been used for this purpose by some of the large lamp makers. As a simple ground detector, the galvanometer is quite complete in itself, being conveniently mounted in a handsome mahogany case with leather strap.



QUEEN PORTABLE D'ARSONVAL GALVANOMETER.

THE CUSHMAN DYNAMOS AND MOTORS.

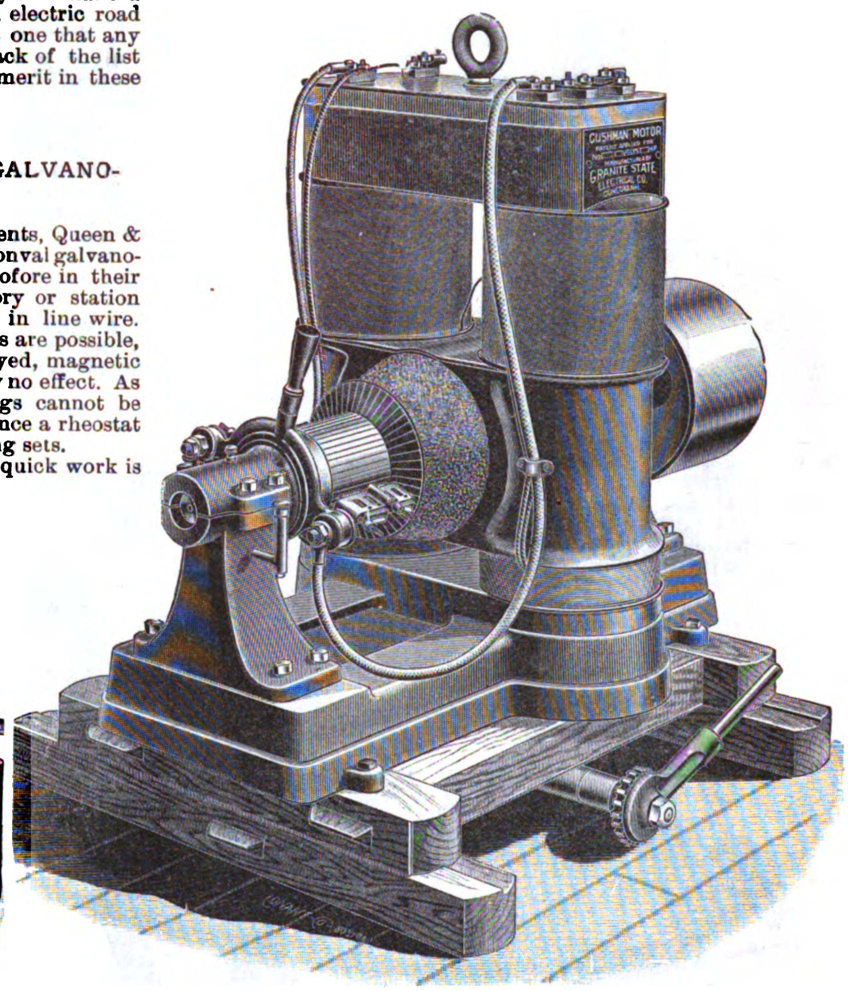
THE accompanying engraving represents the new Cushman dynamo and motor recently brought out by the Granite State Electrical Company, of Concord, N. H.

The most striking characteristic of the machine is the magnetic circuit. This is of the well-known horseshoe type, reinforced by smaller additional magnets near the base, whereby a perfectly balanced field is secured. This is an important feature, as it prevents all heating at the journals and increases the efficiency of the machine.

The field magnets are composed of the best Swedish iron, sunk into the pole pieces, the space for the wire being cylindrical, assuring a smooth and perfect winding; each layer is insulated from the next, thus avoiding all chances of short-circuiting, and the whole machine is tested to a resistance of 1,000 ohms per volt.

The armature is of the drum pattern, built up of alternate sheets of the best charcoal iron and paper, insulated with canvas, shellac and mica, and wound with the best double cotton-covered magnet wire.

These machines are built in sizes from 1 to 50 h. p. and the greatest care is exercised in the selection of the material and workmanship entering into their construction.



THE CUSHMAN DYNAMO AND MOTOR.

NEW YORK NOTES.

THE INDIA RUBBER COMB CO. and the Goodyear Hard Rubber Co. of 9, 11 and 13 Mercer street, this city, have recently become general selling agents for the Chicago Electric Wire Co. of Delaware. A neat little manual has just been issued devoted to these high grade wires and cables. The two New York concerns named have issued a circular to the trade, calling attention to these goods and to the many features of excellence claimed for them.

THE GARVIN MACHINE CO. of Laight and Canal streets, has for sale the entire machine tool equipment of the United Electric Traction Co., of Marion, N. J. They are of standard makes, and in fine order. This is a rare opportunity to secure a set of fine machinery, or individual pieces, at a low price.

THE CRESCENT INSULATED WIRE AND CABLE CO. of Trenton, N. J., has just issued a new catalogue of its insulated wires and cables for telegraph, telephone and electric light cables.

PHILADELPHIA NOTES.

THE PHILADELPHIA ENGINEERING WORKS, LIMITED, have the following orders for their Philadelphia Corliss engines under erection: One 13x36 special Corliss engine for Pennsylvania Railroad Co.; one 22x48 Philadelphia Corliss engine for Delaware County Construction Co., Clifton Heights, Pa.; one 12x30 Philadelphia Corliss engine for Harrisburg School Board, Harrisburg, Pa.; one 14x36 Philadelphia Corliss engine for Trenton Cotton Mills, Gastonia, N. C.; one 12x30 Philadelphia Corliss engine for Chatham Manufacturing Co., Elkin, N. C.; one 16x42 Philadelphia Corliss engine for Colorado City Glass Co., Colorado City, Colo.; one 26x50x54 cross compound condensing for Pennsylvania General Electric Company.

THE E. E. & S. NEW PORCELAIN SPECIALTIES.

The Electric Engineering and Supply Company, of Syracuse, N. Y., who have already brought out a number of specialties that have become standard, have recently added to their list of successes a porcelain covered branch block which is illustrated in the accompanying engraving, Fig. 1.

In order to satisfy the underwriters' requirements and at the same time improve the appearance, and add to safety and convenience in use, these branch blocks have been fitted with porcelain covers. They are made of the well-known "Syracuse" porcelain, neatly finished and held in place by a thumb nut. These are readily removed by the fingers, avoiding the necessity of screw driver or pliers and rendering the block unusually easy of access. The cover protects the connections from dirt and accumulation of floating particles and in case of a melted fuse retains the metal and prevents possible damage.

The blocks are strong and compactly made, of ample carrying capacity and easily wired and the main and branch wires are separated by projections from the porcelain base, while both are held away from the ceiling. The blocks have been endorsed by the underwriters.

Another of the company's recent products is their "fusible wall socket," shown in Figs. 2 and 3. This is a combination of their well-known socket with fused detachable base and wall standard. As the two parts of the base are not fastened by screws, no tools are needed to separate them, a simple quarter turn being sufficient, and the contact is always sure. A special feature is the fact that the fuse is carried on the removable part. When necessary to replace the former the socket is removed and the work done without danger of accident or short circuit. This combination can be used in many cases instead of more expensive fitting, for side brackets, temporary and advertising work, where rosettes and cut-outs would otherwise be necessary. It is made with the various types of sockets now in use, both key and keyless.

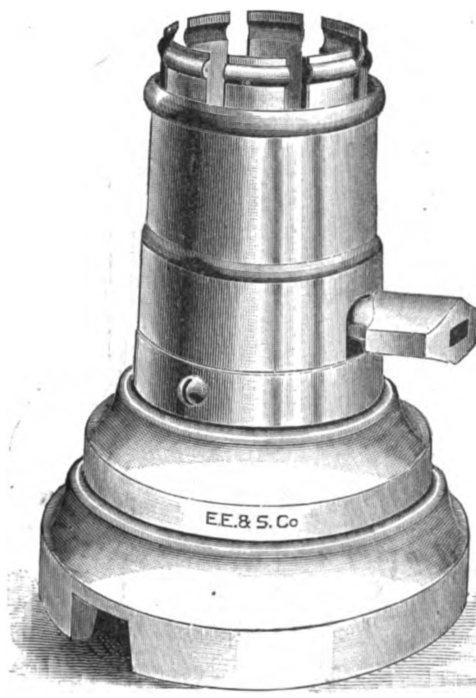


Fig. 2.—"Fusible" Wall Socket.

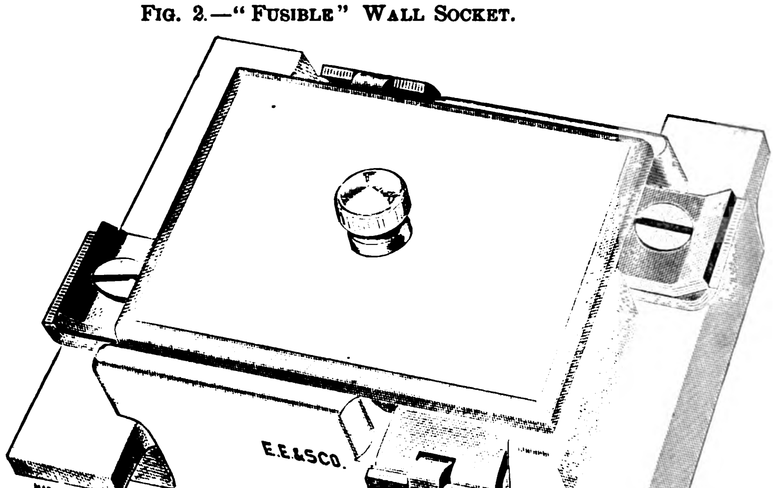


Fig. 1.—E. E. & S. Porcelain Covered Branch Block.

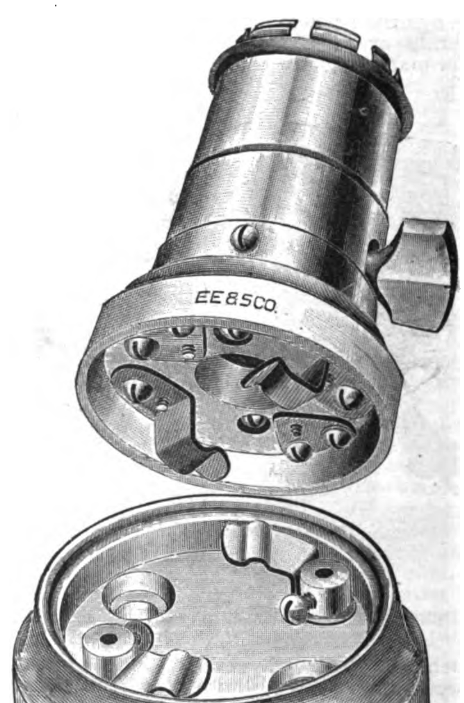


Fig. 3.—"Fusible" Wall Socket.

GUARD WIRES FOR NEW YORK TROLLEY ROADS.

Dr. S. S. Wheeler, the electrical expert of the Board of Electrical Control made a report at last week's meeting of that board in reference to the system of poles and wires to be used by the Union Railway Company on its trolley roads in the annexed district. The report dealt especially with the use of guard wires such as have been put on the Port Morris branch.

The board decided to require the company to use the centre-pole system in the wider streets and the side poles in the narrower ones.

THE NEW "OKONITE" CATALOGUE.

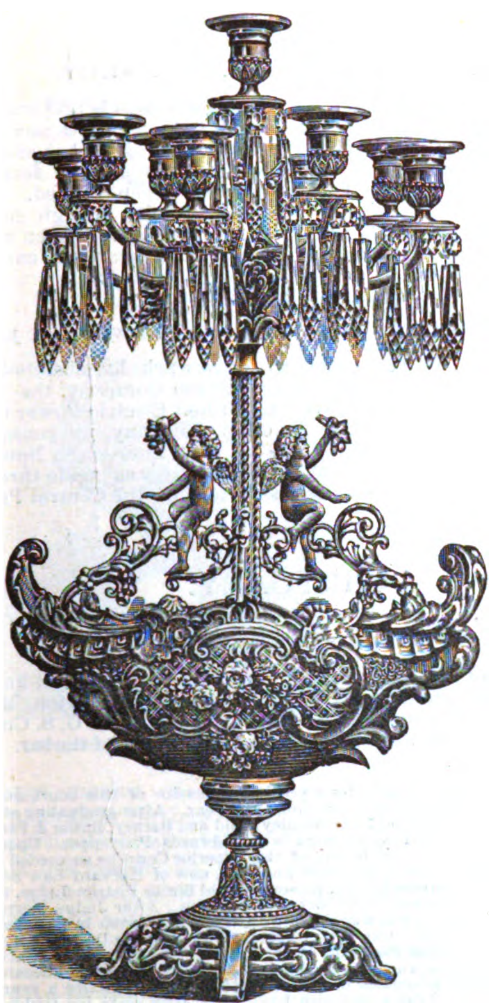
A very handsome and useful new catalogue has been issued by the Okonite Co. of 13 Park Row, devoted to their celebrated specialties in wires, cables, etc. They have made an innovation in the old method of arrangement, by making three thicknesses of insulation, covering *low tension currents*, or currents used for incandescent lighting, bell work, telephone and telegraph; *medium tension currents*, or currents more especially adapted for electric railways and telegraph, and *high tension currents*, especially adapted for currents of high voltage.

Besides these they have included line wires, tubing and tapes, both Okonite and Manson, the former being used especially where high insulation is a factor, and the latter or Manson tape, for protection against abrasion and dampness. The catalogue is full of tables and data, and is, moreover, fair to look upon.

George Cutter is importing a fine line of French carbons which are said to be superior to any on the American market.

NEW JERSEY LAMP AND BRONZE WORKS.—SOME NOVEL FIXTURES.

THE above enterprising concern have just brought out a number of new fixtures for electric lighting, and have shown an intelligent appreciation of electrical journalism by naming some of the pieces after electrical papers. THE ELECTRICAL ENGINEER has been thus honored, and we illustrate herewith the style bearing its name. We trust it will have as large a circulation as its namesake. It is a pretty candelabrum made for electric lights of the wax candle form, with miniature incandescents intermixed with flowers in the vase above the base. It is specially intended for use at weddings, banquets and festivities of a public or private character. There is a growing demand among caterers for such an article, and superintendent G. Wilfred Pearce, of the works, shrewdly opines that firms in the electrical supply business can make a good profit by renting out such articles. We think he is right, and hope that THE ELECTRICAL ENGINEER style will long



"THE ELECTRICAL ENGINEER" CANDELABRUM.

help to brighten and gladden many a happy scene. The works have just issued a new edition of their illustrated catalogue, and we recommend our lighting and supply readers to get a copy.

ANSONIA ELECTRIC CO.

THE ANSONIA ELECTRIC COMPANY, of Chicago, were recently awarded the contract for the entire equipment of Stanley transformers, Helios arc lamps for street lighting, Shield Brand moisture proof wire, for line wire, and other line supplies by the Hillsdale Common Council. This plant will have a capacity of about 2,000 lights in converters and about 50 arc lamps. The Hillsdale Council, decided on using the Helios lamp and Stanley transformers after most carefully investigating practically all other systems on the market and the contract was awarded by a unanimous vote.

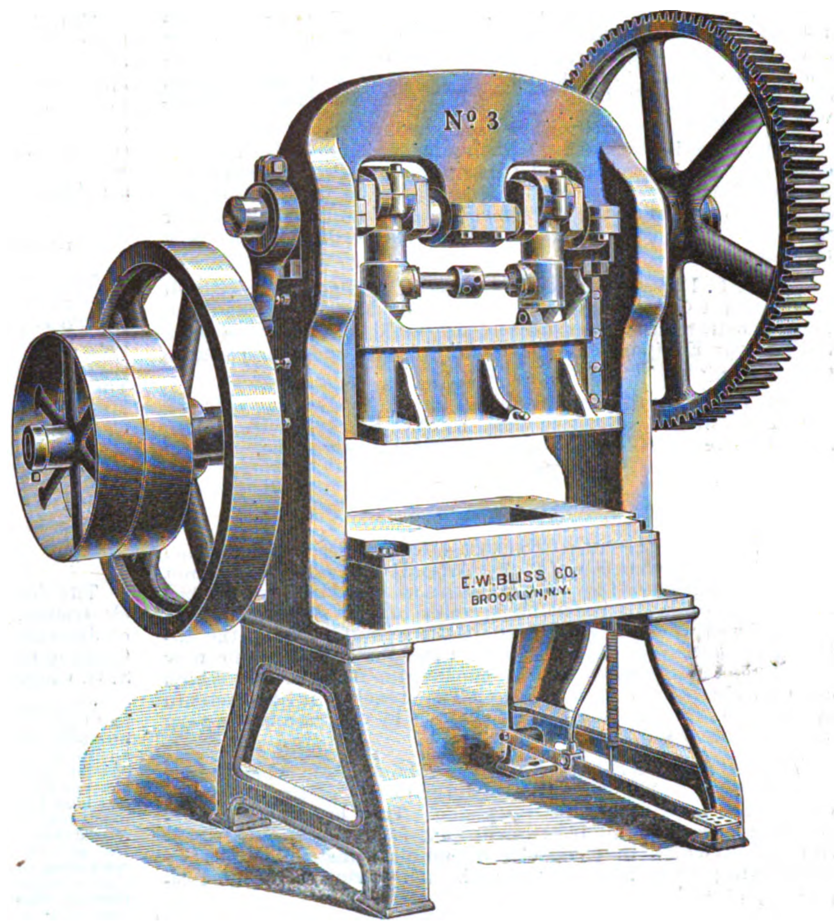
The Ansonia Electric Co., are making large sales in the Wirt dynamo brush, one good sized order coming from the National Metal & Electric Co., Cleveland, Ohio. The Maquoketa electric light plant, recently equipped with Helios arc lamps furnished by the Ansonia Electric Co., is to begin operating its street circuits at once.

THE NEW BLISS No. 3 DOUBLE CRANK PRESS.

THE accompanying engraving represents the new No. 3 double crank press of the E. W. Bliss Co., of Brooklyn, N. Y.

This press embodies a new design of the frame (which has also been considerably strengthened) and a new method of connecting the two pitmans so as to enable the operator to quickly raise and lower the slide without danger of getting the two pitmans out of alignment with each other and with the guides.

This press is largely used in the manufacture of armatures, dripping pans, coal hods, vapor stoves, wrought iron ranges, paneled ceiling and siding, cornice work, etc. It is specially adapted for operating large cutting, forming, perforating and bending dies. It can also be made without gearing and with overhanging frame instead of the straight uprights shown. Its principal dimensions are 36" between the uprights; 2 to 4" stroke; die space (up and down) 10"; 2" adjustment; height, 90"; weight, 5,500 lbs.



NEW BLISS NO. 3 DOUBLE CRANK PRESS.

The company also make similar presses in many other sizes up to 50,000 pounds in weight.

MR. L. A. CARR.

A CHANGE in the management of the Schenectady Street Railway Company, the Schenectady Gas Company and the Illuminating Company took place recently. About two weeks ago, L. A. Carr resigned his position as general manager of the above-named companies on account of ill health and he has been succeeded by H. S. Cooper, of Washington, D. C. Mr. Carr during his stay in Schenectady has made a host of friends, and has proved himself a painstaking and capable official. He is taking a trip through the West with a view to recuperating his health.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., have issued their usual Fourth of July "stationery." It consists this year of a huge cracker, about as unstationary a thing as one could well imagine except a London "squib" or a Paris mob.

NEW YORK NOTES.

F. H. SPARLING & Co., 44 and 46 Broadway, have been doing very well for a young firm in dull times. They have recently constructed five miles of road for the Tennallytown and Rockville Railway Company at Washington, D. C., and sold large quantities of wire to the Lebanon & Myersville and the Chester, Darby and Philadelphia roads. Mr. Sparling has associated with him R. M. Robinson, W. S. Shannon and Albert Bernstein.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS has just issued a new list of members and catalogue. It embraces some new and interesting features, among them being the geographical distribution of the members, a calendar of meetings, the rules and a cut of the new Institute Badge. Copies will be mailed to members or other persons on application, either from New York headquarters or from the World's Fair exhibit.

J. H. BUNNELL & Co., 76 Cortlandt street, this city, have just issued a new edition of their catalogue, the present issue being No. 13. It is a book of no fewer than 224 pages, which illustrate and describe an endless variety of useful and standard articles, apparatus, supplies, etc., for all branches of electrical work, from a push button up to a central station or an electric railway. It is a very handy and serviceable publication.

MR. JOSIAH R. T. DAVIS, C. E., has opened an office at Room 104, Havemeyer Building, where he will practice as a consulting and contracting engineer, paying special attention to electric railways. He has already done some construction work in this field, one road he has built being for the Williamsport Passenger Railway Company.

THE FITCH BATTERY & ELECTRIC CO., of Oneida, N. Y., have sold out to the Galvano-Faradic Manufacturing Co., of 300 Fourth Avenue, New York city, who will hereafter be the sole licensee and manufacturer of the "Perfect Battery" and excitant, under the D. P. Fitch patents, and to whom all orders should now be addressed.

MR. J. L. LUDWIG, of the Havemeyer Building, this city, will represent the Green engine of the Altoona Manufacturing Company, illustrated in THE ENGINEER last week. He also represents the Railway Equipment Company, of Chicago, and is prepared to contract for electric railway work.

THE ELECTRIC SERVICE COMPANY OF BUFFALO was referred to recently in this column as the "Electric Secret Service." Our apologies are due the company for giving it a new name.

WESTERN NOTES.

THE ANSONIA ELECTRIC COMPANY.—The articles now furnished for overhead construction by the Ansonia Electric Co., are not only being recognized by electric roads as standard fixtures, but are also becoming popular on account of the superior class of material and workmanship, used in the manufacture of the different devices. The Ansonia Co., have just placed their new adjustable pipe bracket on the market, the first order of which 300 were shipped to Piqua, Ohio. The bracket is handsome in appearance, and can be placed in position by one man in the very shortest time possible.

THE ELECTRIC APPLIANCE COMPANY have been working for some time in the telephone line with the idea of getting up a first-class non-infringing electric telephone. They have at last succeeded in securing an instrument that is satisfactory to themselves, and which they consider a first-class instrument. They promise to proceed at once "to make a few ripples in the telephone puddle."

MR. A. D. ADAMS, manager of the Commercial Electric Co., Indianapolis, was a Chicago visitor this week and was a welcome caller at the ENGINEER.

NEW ENGLAND NOTES.

COE BRASS MANUFACTURING COMPANY.—The new machine shop of the Coe Brass Manufacturing Company, will be 40 feet wide and 300 feet long, two stories high. The building is designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., and will be covered with their patent anti-condensation corrugated iron roofing.

DIFFERENCE OF PHASE.

M. DÉSIRÉ KORDA has utilized an interesting property of the electric current to measure directly the difference of phase of two sinusoidal currents of which neither the strength nor periodicity is known. A coil placed in a thin rotating magnetic field, in synchronous rotation therewith, cannot have currents induced in it as long as the diagram of the field remains a circle, and if at the same time the axis of rotation remains perpendicular to the plane of the field. But when one or other of these conditions ceases to be fulfilled, especially when the intensity of the field is represented by an ellipse, a current is set up in the wire having twice the number of periods that the field has.

MR. PAUL T. KENNY.

MR. PAUL T. KENNY, of this city, has left for Europe, Asia and Africa, via S. S. "Campania," and expects to be absent about six months on a pleasure tour, taking in Berlin, Vienna, Buda-Pesth, Belgrade, Constantinople, Asia Minor, Palestine and up the Nile to the second cataract, returning via Algiers, Morocco and Spain. After leaving the Mather Company a few months ago, he began operations as an independent electrical contractor, making a specialty of electrical transmission of power, and his last contracts for motors taken in Brooklyn alone, before leaving, were as follows: Blake Manufacturing Company, 20 h. p.; Hemblen Manufacturing Company, 50 h. p.; Pellissier, Jeunes & Rivet, 20 h. p.; estate of A. Froelich, 20 h. p.; D. W. Binns Foundry, 15 h. p.; Goetz & Sons, 4 h. p.

TO LIGHT STEAM CARS BY ELECTRICITY.

THE Albany *Argus* says: The Central-Hudson is preparing to light its cars by electricity. The system to be used is a new one. Connected with an axle of each car is a small dynamo, and the electricity generated while the car is in motion is to be accumulated in a small storage battery for use when needed. It is claimed that in a run of eight hours electricity enough can be stored to light a car for 36 hours. Experiments have been made with a car equipped with the apparatus which were entirely satisfactory.

UNION OF ELECTICAL INTERESTS AT NEWARK, N J.

THE CENTRAL POWER COMPANY, of Newark, has absorbed the Newark-Schuyler Electric Light and Power Company, the Electric Power Company of Newark, the United Electric Power Company, and the United Electric Traction Company, the consolidation practically cleaning up all the old Daft interests in Newark. The transfer of the United Traction Company was made through Mr. J. M. Smith, who is now the secretary of the Central Power Company.

OBITUARY.

WM. STANLEY, SR.

THE death of Mr. Wm. Stanley, Sr., father of the well-known electrician, Wm. Stanley, Jr., occurred at Great Barrington, Mass., on June 28. Fitting testimonials were paid him in the U. S. Circuit Court in this city on June 30, by his old associates of the bar. Mr. S. G. Clarke said:

"Mr. Stanley was for nearly forty years a counselor of this court and for half that period a most active practitioner at its bar. After graduating at Yale he studied law in the offices of David Dudley Field and Barney, Butler & Parsons, and for some time was managing clerk with Edwards Pierrepont. Upon the election of the latter to the bench of the Superior Court he succeeded to his practice and associating with him Prof. Langdell, now of Harvard Law School, and later the Hon. Addison Brown, present United States District Judge, he for many years conducted a large and lucrative practice. After Judge Pierrepont retired from the bench he was associated with these gentlemen in business. In 1869 and 1870 Mr. Stanley was first Assistant United States District Attorney, conducting in court during that time nearly all of the matters in which the United States was concerned. A little over twenty-one years ago I became his partner, remaining so associated until his retirement from practice a year ago. From such association I can speak with knowledge, both as to his faithfulness and zeal for his client and his fidelity to the court. Earnest, zealous, and strenuous for what he believed to be the right, there was never anything underhanded in his methods or any attempt to mislead the judge or hoodwink the jury. In the preparation of his cases no care or labor was too great, and while not eloquent, the manner in which he talked over the evidence in summing up to the jury, taking them into his confidence, as it were, to consider on the whole what was fair and right, was extremely effective. He was well grounded in the principles of the law, and while not preëminently case-learned he always knew his own case and the facts and principles to sustain it. As a lawyer he might well be taken as a model in that he always reverenced the earlier traditions of the bar and to the last regarded the practice of the law as a profession and not a trade, and believed with the greatest lawyer of Rome, that the greatest inheritance was right and government by law. *Major hereditas venit unicuique nostram a jure et legibus, quàm a parentibus.* These views, added to his natural kindliness of temper, made him the friend and efficient aid of every young man who sought to become a lawyer in the better sense of that name, and to all such he was indeed a counselor."

The words of esteem and admiration will be echoed and emphasized by many in the electrical field who had the pleasure of knowing Mr. Wm. Stanley, Sr.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

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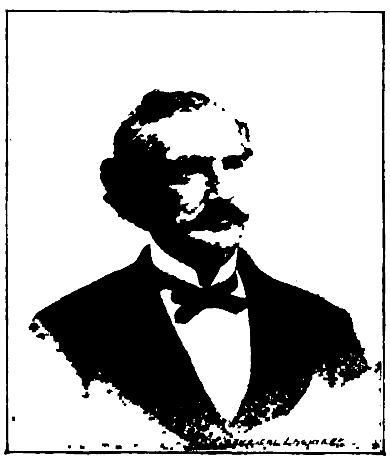
THE ELECTRIC RAILWAY WORK OF DR. COLTON IN 1847.—THE FIRST USE OF TRACK AS CIRCUIT.

BY

T. C. Martin

I.



Gardner Quincy Colton.

FROM time to time the missing chapters in the early history of the electric railway art are being supplied, and although there were many gaps a few years ago in the record, very little is now wanting to complete it. The recent interest in the historical side of the subject is largely due, of course, to the sudden and enormous development of a new industry, and to the fact that a large number of people as well as large masses of capital are affected by electric railway patents or devices which have hitherto been without any particular importance. Moreover, it is only now that the art has neared its right perspective, so that one may know what in it is of lasting value and what is ephemeral and insignificant. Even thus, it has been surprising to one like myself whose sole aim is to give credit where credit is due, to discover how many men have been long at work in obscurity on things that inventors of the later, larger day, have fondly heralded as their own peculiar triumphs. As a matter of fact, the electric railway shows itself in all its broad essential features, to be more and more a remote and ancient creation; so that Davenport with his little toy road in 1837, is a legitimate predecessor of Farmer and Page; of Finney at Pittsburgh; of J. C. Henry in the far West; of Van Depoele in Michigan and Indiana; of Daft on the New York Elevated; of Field at the Chicago Railway Exposition; and of Sprague storming the slippery heights of Richmond.

Some six years ago, with my friend and associate, Mr. Joseph Wetzler, I had the honor of presenting to the public the first American book on the electric motor and its applications. In that work were included as far as could then be ascertained the names and achievements of all who had done anything to promote and perfect the electric railway art in America, and it is some satisfaction to find that even then, at a period when barely a score of roads were in operation and when the desirability of the utmost fullness of record was not well appreciated in general, so little escaped our notice. But there was one passage which, while it sufficed at the time, has long piqued my curiosity and set me on the watch for ampler information. I refer to the following, with which Chap. III., page 28, of the first edition, closes:

Mention may also be made here of the electric locomotive devised in 1847 by Mr. Lilley and Dr. Colton, of Pittsburgh. This locomotive was driven around a circular track by electricity. The rails were insulated, each connecting with a pole of the battery, and the current was taken up by the wheels, whence it passed to the magnets, upon whose alternate attraction and repulsion motion depended.

This description is fairly explicit, but the personal references are very vague. So far as inquiry went, there was no Dr. Colton living in Pittsburgh in 1847, and certainly no one of that name there lately, who had done such early and interesting work as this. I have understood that Commissioner of Patents Butterworth referred once to this Dr. Colton as an "apochryphal personage," and I began to fear that I had lent my aid in building up a historical myth. Neither Mr. Wetzler nor I had any reason to doubt the accuracy of our statement, yet we were without means for its verification.

II.

Matters thus remained until the recent issue of electric railway patents to George F. Green, of Kalamazoo, Mich., and their acquisition by the General Electric Company, gave new interest to the identity of this mysterious and elusive Dr. Colton. In 1879, Green applied for a patent which was not issued to him until December 15, 1891, covering the use of the rails as part of the circuit of an electric railroad. The scope of the invention thus awarded him may be inferred from the following claim 3:

3. The combination, substantially as set forth, of a railway track, one or more stationary means of electric supply, electrical conductors extending from said means of electric supply along the lines of said track, *and consisting wholly or in part of the rails thereof*, vehicles movable along said track, electrodynamic motors fixed upon said vehicles for imparting motion thereto, and wheels supporting said vehicles upon the track, and also serving to maintain continuous electrical connection between said means of electric supply and said motors, substantially as described.

Green also secured a patent on the same date covering broadly the use of circuit controllers on such cars; but, as will be seen, the main interest in his work centres on claim 3 which covers exactly the same thing as Dr. Colton is said to have done nearly fifty years ago. It may also be pointed out that on July 16, 1889, Mr. Stephen D. Field obtained a patent applied for in 1880, covering the idea said to be Green's with the addition of the use of dynamos. The first claim of Mr. Field's patent runs as follows:

1. The combination, substantially as hereinbefore set forth, of a stationary dynamo-electric generator driven by a suitable motor, a *circuit of conductors composed in part of an insulated or detached section of the line of rails of a railway track*, a wheeled vehicle movable upon or along said insulated section of track, an electro-magnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit-controlling device placed upon said vehicle.

It will be noted that this patent claims specifically a dynamo electric generator as a source of electric energy, and hence its owners assert that existing electric railways are subject to it. It is safe to assume that unless Dr. Colton's actuality were vindicated, and the accuracy of our story established, half a dozen other patents on the same thing would soon be granted by the complaisant Patent Office.

I am glad to say that later and renewed efforts have discovered Dr. Colton and determined his identity. As usual in such cases the evidence was not far to seek. It needed turning up. But it is not everybody's luck to be a Sherlock Holmes, though one may modestly be another Stanley to another Dr. Livingstone.

III.

Gardner Quincy Colton, whom one might speak of as having been an electric railway pioneer in spite of himself, is alive and hearty, though born two years before the battle of Waterloo. He is to-day a resident in New York City and the proprietor of the Colton Dental Association, which has its rooms in the Cooper Union, graced with many trophies and souvenirs of its occupant's long career. A fellow-countryman of Thomas Davenport, whose life work Mr. F. L. Pope described in these pages so gracefully two years ago, Colton was born in Vermont in 1814, the youngest of 12 children, some of whom have attained a greater age than himself. The vigor and tenacity on life of the family are an inheritance from the father, sprung from clean and sweet Pilgrim stock, and living to the age of 98, less four months. Young Colton was brought up among the green hills of Vermont and then sought education and fortune in New York. He directed his studies to medicine, under Willard Parker and at the College of Physicians and Surgeons, and soon found that he could make money for his own support by giving popular lectures embellished with experiments in natural philosophy. He had noted in his studies the peculiar effects of "laughing gas," and gave this a prominent place among his experiments. The earliest of these lectures were naturally given in New York City. The scene was the famous old Broadway Tabernacle, and the year, 1844. At one of these lectures, Dr. Colton was enabled through the kindness and co-operation of Prof. Morse to read a copy of the first telegraph message received, it would seem, over the new line then opened. His acquaintance with Prof. Morse, a man of temperament and training greatly resembling his own, was very valuable to him, and he still possesses a beautiful model of the Morse register presented to him for his demonstrations by the inventor of the electromagnetic telegraph.

IV.

Incidentally it may be mentioned that Dr. Colton had already associated his name with another of the great advances of the age. I have alluded to his partiality for laughing gas. During a trip through his native New England in 1844, he was giving at Hartford, Conn., an exhibition of the ability of the gas to render people oblivious of their surroundings, when Dr. Horace Wells, a local dentist, was impressed with the idea that with the help of such an agency teeth might be extracted without pain. The trial was made on December 10 and 11, 1844, successfully, and the discovery of anæsthesia dates from that time, as all surgical operations had previously been made with no relief of the kind, and often with immediately fatal effect. Since that time Dr. Colton has himself administered laughing gas to nearly 200,000 dental patients, without a single failure. A handsome monument has been erected in Hartford to the memory of Wells, who had suffered heartbreaking neglect in his day, as the discoverer of anæsthesia; and if monuments went for much, one would like to see Dr. Colton similarly remembered with a block of granite.

It was probably from his connection with electrical matters that when Dr. Colton determined to enlarge his field of operations and become a peripatetic philosopher, he made up his mind to include in his apparatus a little electric railway. Davenport had already shown such models in New York, and in 1847 Moses G. Farmer showed his electric locomotive; while a few years later, in 1851, at Boston, Mr. Thomas Hall exhibited another car to which the current was fed through the rails. Hence the inclusion of such apparatus need not surprise us; but it is worthy of note that four years before Hall, Colton employed this method of supplying the current to his road. In 1847 he had built for him by a well-known model maker, Mr. "Lilly," then carrying on business, he thinks, in Liberty street, an electric locomotive about 14 inches long and 5 inches wide, on which was mounted a "vibrating" motor for propelling it. The Doctor, who has not tried to keep pace with electrical development, still believes in the great value of reciprocating motors, as do perhaps a few others; and it really seems unkind to tell him that the type is as antediluvian as the megatherium. He is certainly entitled to enjoy any old-fashioned beliefs he may cling to, and the wonder is that a man so progressive has any left at all.

This electric locomotive, Dr. Colton tells me, drew a train of four cars each about the same size as the engine, and in lieu of passengers had dolls placed in the windows. The track consisted of a wooden ring or felly about eight feet in diameter. The two rails were formed by thin bands of iron fastened one upon the exterior rim of the felly and one upon the interior, both being bridged by the locomotive, and the upper edges projecting far enough above the wood to receive the car wheels. The modus operandi of this road, in the course of any lecture, was simple. At some distance from the track, dependent upon the size of the stage upon which the exhibition was being made, he placed a battery consisting of four cells of platinum-carbon elements. In giving his lecture, Dr. Colton would speak of the wonders of electricity, describe the engine and its method of operation, and show how one pole or wire of the battery was connected to the one side of the track. Holding the other wire in his hand, he would approach the track and make the connection, completing the circuit through the track rails and motor, whereupon the train of cars would run and the audience would applaud. Dr. Colton appears to have had a very good idea of the range of such an application. He informs me that he would tell his hearers that as far away as New Orleans he could make the influence felt and operate such a system. All that was necessary was to close the circuit and have power enough to do the work. Just what power would be wanted for an extensive road of several hundred miles he never figured out, but he was none the less far-sighted enough to see how the little device he had before him illustrated that which was later to fill the land. Besides, as his friend, Prof. Morse, had said: "If I can succeed in working a magnet 10 miles, I can go round the globe."

V.

Dr. Colton exhibited his railway in New York, in 1847, and thence he went to Albany, Utica, Syracuse and Buffalo. At the last place he met Millard Fillmore—President of the United States—and also a Mr. Lonidieu, both of whom gave him letters of introduction, one being to the editor of the Cincinnati *Gazette* and one to Judge Bond, a well-known lawyer of Cincinnati. From Buffalo he went to Pittsburgh, and there called upon the gentleman who had been Mayor of Pittsburgh, in 1845, at the time of the Pittsburgh fire and with whom he had previously had correspondence. It appears that Dr. Colton had given a benefit exhibition of laughing gas at Boston, and had sent the proceeds, $81, to the Mayor shortly after the fire. This kindly act repaid itself. By the Mayor he was now introduced to the editors of the various papers at Pittsburgh, and his reception was most cordial. He then went

to Cincinnati, Louisville, St. Louis, Memphis, New Orleans, and Mobile, and then, as he now recollects it, returned to New York, although he thinks it quite possible he may have gone in the course of his trip to Detroit and perhaps other places in Michigan; so that it is quite possible that Green may have seen his exhibition.

Some of the press notices that I have secured, are worth quoting. In the local columns of the Pittsburgh *Post* of August 5, 1847, there appears the following:

On this evening, Dr. Colton will give the third of his amusing lectures and exhibitions, on which occasion he exhibits and sets in operation three electric engines, propelled by electricity. One of these it is said can be applied to propel the largest machinery. It is truly a wonderful invention.

The following is an advertisement in the Pittsburgh *Post*, of August 23, 1847.

Electric Magnetism, Natural Philosophy and "The Court of Death."

Dr. Colton respectfully announces that he will give a series of lectures with a great variety of brilliant practical experiments in Electro-Magnetism, Natural Philosophy and Chemistry at Philo Hall, commencing Monday evening August 23, with a change of subjects and experiments every evening.

The Magnetic Telegraph will be erected in the Hall with galvanic wires and regulators and messages will be transmitted across the Hall on the wires. The whole construction and operation will be explained. After the Telegraph, a series of brilliant Philosophical experiments will be shown and explained. For a particular account of the entertainment, see small bills.

At the close of each lecture, the great and magnificent painting, "THE COURT OF DEATH" will be exhibited and explained.

Admittance to the whole, 25c., children half price, if accompanied by their parents.

In the Pittsburgh *Post* of Sept. 4, 1847, appears the following:

LAST EXHIBITION.

Dr. Colton announces that he will give the closing exhibition of the Nitrous Oxyde, or Laughing Gas, at the Athenæum Musical Hall, Liberty Street, near Wood, Saturday evening, Sept. 4. Dr. Colton has the pleasure to announce that on this occasion, ten gentlemen, six of whom are lawyers, will inhale the Gas. Previous to the exhibition of the Gas, Dr. Colton will repeat the best of all amusing Philosophical experiments, which he has given during his course at Philo Hall. The Magic Slipper, the gold piece and Magnetic Machine, Colt's Submarine battery, the Reciprocating Engine.

He will also exhibit a circular railroad with an engine upon the track driven around by electricity. But the electricity instead of being applied to the engine, will be applied to the track. The whole being conducted like the two previous in such manner as to deserve the patronage of an intelligent class of ladies and gentlemen. Exhibition to commence at a quarter of eight o'clock.

The Pittsburgh *Gazette*, of September 2, 1847, contains the following:

Curious Invention.—Dr. Colton has invented a Circular Electro Railroad, with an engine upon the track propelled around by electricity applied, not to the engine, but to the track. The power which moves the machinery is stationary, while the engine moves off with wonderful rapidity.

We understand Dr. Colton intends to give one more of his interesting and scientific lectures before leaving the city, and among other experiments, will introduce and explain his new invention. Dr. Colton has been thus far well patronized, and we believe has rendered entire satisfaction to all. The next and last lecture will take place on Saturday night at the Athenæum.

The frequent references to the peculiarity of the track and its function will be noted. Similar notices adorn the Cincinnati journals—*Gazette* and *Enquirer*. The latter remarks that the current is applied to the track instead of to the motor. Even to-day the track gets more than its fair share. The *Gazette* enlarges on the fact that as the "engine" passes around, "the sparks of electricity can be seen to fly from the electrified track to the engine." The same sparks are still with us, and every reporter describing the new trolley road as it goes into operation matches the pyrotechnics of the track with some of his own regarding them. After all, we haven't travelled very far electrically since the "electric double reciprocating engine" dazzled and diverted the Western folk of 1847, puzzling them with a phenomenon that still wearies the intellect of many a modern alderman, namely, that "The engine goes, but the power which moves it is stationary."

VI.

It need not be a marvel that after so long a stay in Pittsburgh and with so many eulogistic notices, the chroniclers of the time conferred on him the citizenship of the place, and that he thus passed into history. The "great and magnificent painting" referred to, the "Court of Death," was a very large allegorical canvas painted in 1820, by Rembrandt Peale, an American artist of fertility and standing in his day. It was the largest picture in America at the time, Dr. Colton says, and attracted a great deal of notice and favorable comment. He does not know what has become of it, although it cost a considerable sum of money and was sold for a large amount when it passed from his hands. Dr. Colton's usual shrewd plan was to exhibit the picture first and alone, then withdraw it and make it an additional attraction to his scientific lectures, without extra fee. This seems to be the earliest use of the "chromo," as a means of drawing custom. It is evident, however, that Dr. Colton addressed himself to large and cultured audiences. With his electric railway track eight feet in diameter, his picture large enough to cover the wall of a big room, his models of electric locomotives, stationary motors, telegraphs, and his philosophical apparatus, no small hall would contain him; and the attendance was necessarily proportionate in order to make his enterprise profitable.

VII.

I have now gone sufficiently into detail to show what Dr. Colton's electric railway work was, and how very remarkably it anticipated that of a later day, such as that of Green, who with all his ingenuity does not appear to have done anything more than Colton or Hall in the use of the track as part of the circuit. I need not follow the Doctor very closely through his later career, though his life has touched the romantic and unexpected all along its course. He grew tired of humdrum lecturing soon after the time of which I have been writing, and though he has kept much of his apparatus down to the present time, had almost forgotten its existence. Stirred up by the news of gold discoveries in California, whither a brother had gone, he became an Argonaut, and was one of the first alcaldes of the embryo city of San Francisco. After vicissitudes of various kinds on the Pacific slope he came East again, returned to his first loves—lectures and laughing gas—and devoted himself to dentistry, an art he still practices daily. He also interested himself, after 1860, in the celebrated War Maps that bore his name. He says of his present vocation: "Perhaps the laughing gas has something to do with my good health. I am inclined to think I shall owe ten years of my life to the good effects of the gas, for I inhale about 20 gallons every day in showing patients how to commence. The gas is just like the air, only containing a little more oxygen. Oxygen is what gives life and vitality to the blood. We *live* on oxygen." Dr. Colton's health, activity and memory are extraordinary for a man nearly as old as Gladstone, for a man whose career spans the century; and I am glad of the opportunity thus to pay my tribute of esteem to one, who through more than 50 years of active life has been in close touch and sympathy with some of its greatest advances and discoveries.

Mr. Anthony Reckenzaun left for Europe on Saturday by "City of New York," after a stay altogether too short for his friends. Part of his time was spent at the World's Fair. His health and professional engagements would not allow him to wait for the Electrical Congress.

A BRIDGE AND COMMUTATOR FOR COMPARING RESISTANCE COILS BY THE CAREY-FOSTER METHOD.

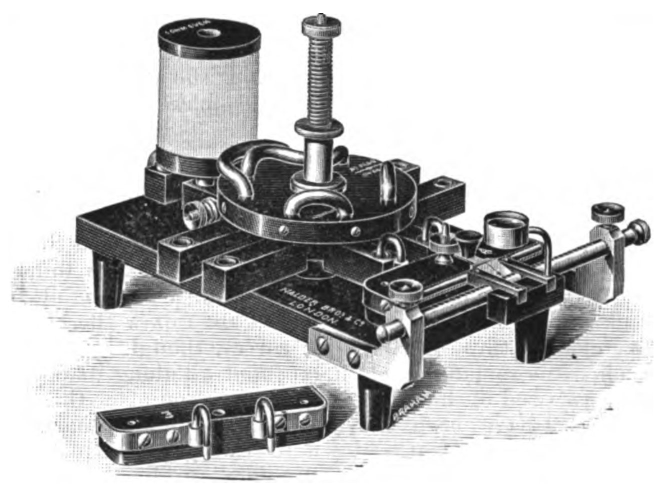
BY

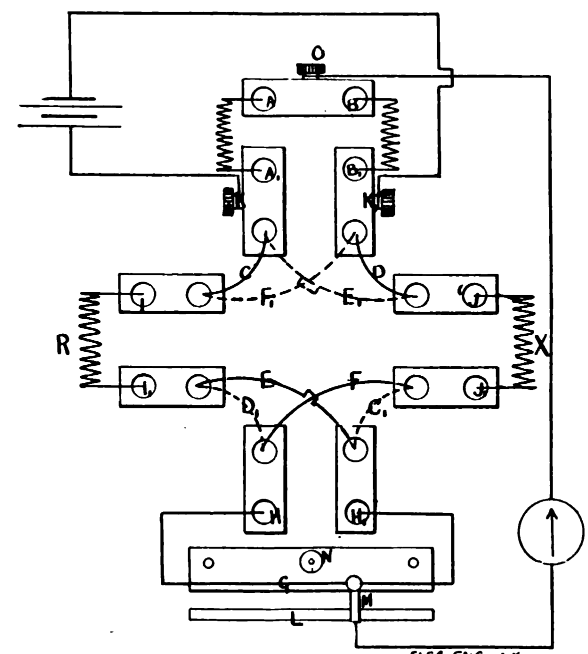
Professor Carey-Foster's method of comparing resistances is so well-known and of so much use that I do not propose to do more than indicate the means adopted in the form of bridge here shown to carry it out.

The instrument shown in Fig. 1, fulfills the two-fold purpose of commutating the resistances to be compared with respect to the ratio resistance coils and a series of bridge wires to be used according to the value of the coils under comparison. As will be seen, it consists of copper bars mounted on an ebonite base and furnished with mercury cups for making the necessary contacts. The diagram, Fig. 2, shows the various connections.

At A, A_1 and B, B_1 are the cups for making connections with the coils which are wound upon one bobbin and usually of the value 1 ohm, 10 ohms, 100 ohms and 1,000 ohms. On each side at I I_1 and J J, are placed the resistances whose difference is to be measured, and at C_1 is the bridge wire mounted on a detachable frame, with the key M which runs on the divided rod L for making contact. C, D, E, F, show the commutator connections in the first position, and after commutation in the position C_1, D_1, E_1 F_1 as indicated by the dotted lines. In order to commutate the coils R and X, the ebonite plate upon which the connections C, D, E, F are mounted is drawn up against the spring which presses the contacts into their respective cups until the guide pin is lifted out of its recess; the plate can then be turned through 180 degs. till the contacts are in the position shown by the dotted lines marked C_1, D_1, E_1, F_1. The galvanometer is then brought to zero by moving the contact key M into another position on its wire. The battery connections are shown at K K_1 and those of the galvanometer at M O.

In order to obtain a large range of measurements, a number of bridge wires are provided, usually about ten, though, if necessary, this number need not be considered the limit. The plates upon which each wire is mounted is detachable as already stated, and in addition to the milled head N, two steady pins are fixed in the base of the commutator so that it, or any other of the series, can always be replaced accurately in position with respect to the scale and key. This apparatus has been in use for the last five years substantially as now shown, and the English Board of Trade Electrical Standards Department have had one in use since July, 1892.





Figs. 1 and 2.—Bridge and Commutator for Comparing Resistance Coils by the Carey-Foster Method

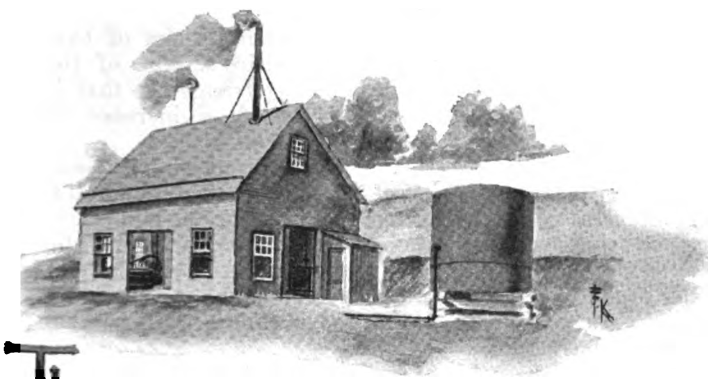
GAS AND WATER PIPES AS TELEPHONE CONDUCTORS.

In a letter to the *Génie Civil*, a correspondent shows there is a difference of potential between the water and gas pipes in all houses, and that if one terminal of a telephone is joined, say, to the water-pipe, on lightly touching the gas-pipe with the other, a crackling sound is heard in the telephone indicating the passage of a current. By replacing the telephone by a galvanometer, it is found that the negative pole is formed by the gas-pipe, and that the galvanometer deflection is permanent and constant in amount during several months, though there is a slight diurnal variation. The author attributes these currents to a slow chemical change in the pipes, which thus form the plates of a battery. However, these observations suggested that the pipes must be fairly well insulated from each other, and might act as conductors for telephonic communication, and he has succeeded in carrying on a conversation, without any other connecting conductor between two houses at a distance of a hundred metres apart. In this experiment the microphone, without any induction coil, was joined to three bichromate cells. It is very easy to see if the experiment will succeed, as it is only necessary to set a small induction coil to work, joining its terminals to the water and gas-pipes; then in all neighboring houses in which, on joining a telephone to the pipes, the sound of the coil is heard communication is good. Even if speech cannot be satisfactorily transmitted, it would be possible to communicate by the ordinary Morse signals.

AN ELECTRIC HORSEWHIP.

The applications of electricity to every-day life seem to be almost infinite; the latest development being an electrical horsewhip described in *Électricité*. This is said to be designed for the use of a "sportsman," and consists of a celluloid handle containing a small induction coil, together with a battery, the circuit being closed by means of a spring push. Two wires carry the current to the extremity of the whip, which is furnished with two small copper plates having points fixed to them of sufficient length to penetrate the coat of the horse, and yet not being sharp enough to inflict a wound.

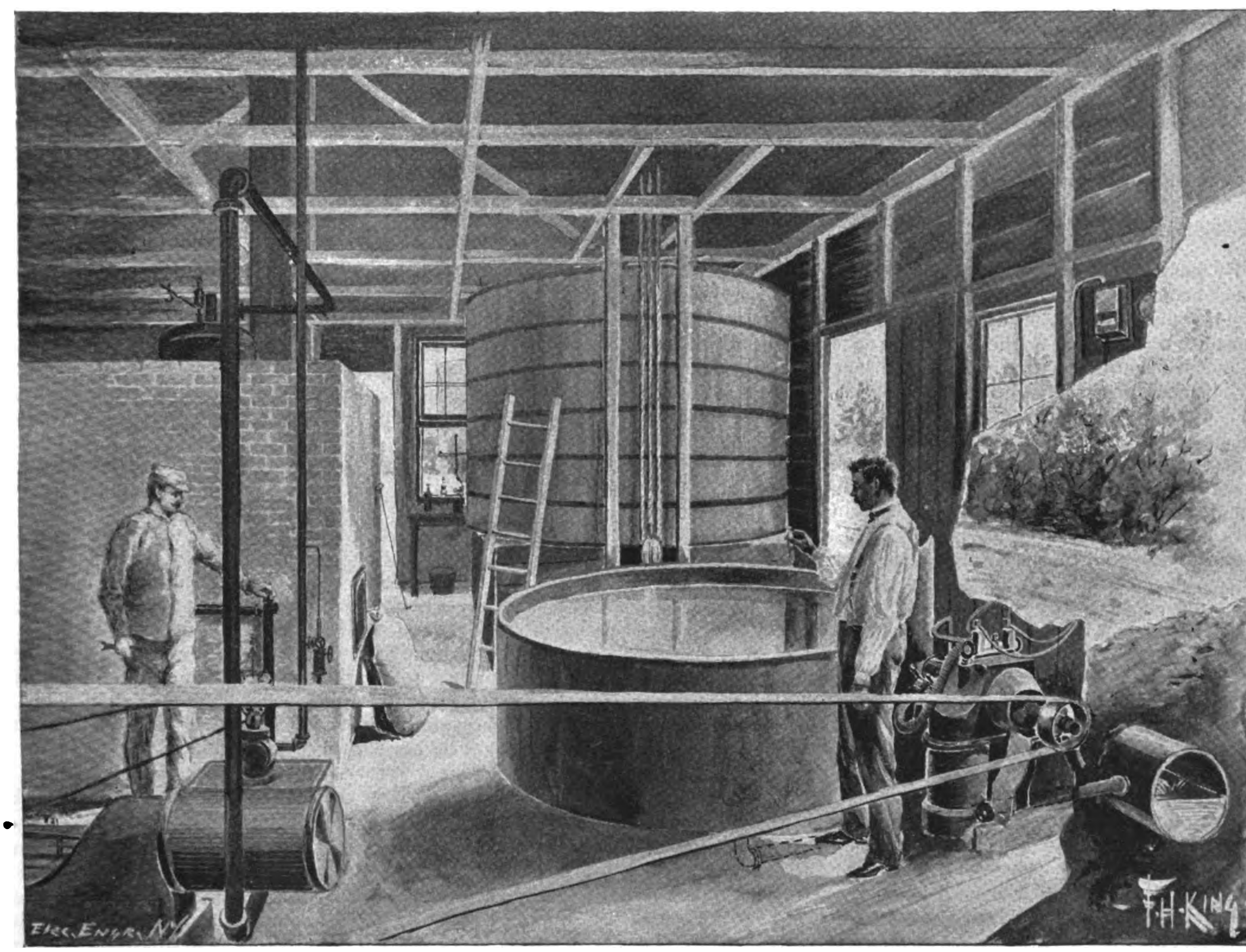
THE WOOLF ELECTROLYTIC DISINFECTANT.



The REAPPEARANCE of that dreaded scourge, cholera, in Europe and the chance that it may be transmitted to this country has naturally led our medical authorities to exert themselves to the utmost to render sanitary conditions as perfect as possible. It is generally recognized that cholera is due to a germ which finds its way into the stomach and intestines, being usually conveyed through the medium of the drinking water supplied in cities; it was, indeed, established beyond doubt that the terrible plague of Hamburg last year was due to the pollution of the river Elbe, Hamburg's old source of water supply. While it is true that the water can be sterilized and made safe for drinking by boiling, the fact remains that the process, simple as it is, is applied in but a small minority of cases. This is well recognized among sanitary authorities with the result that the conclusion has been reached that true relief must be looked for in the purification of the water supplied before it reaches the consumers.

It has been noted that the pollution of drinking water for city purposes is most frequently due to sewage, which is either led directly to the waters serving as a source of supply or finds its way into such sources by percolation through the earth ; in either case, unless measures be taken to destroy the disease germs or other compounds, usually of a nitrogenous nature, the result is inevitably a large increase in zymotic diseases. The purification of sewage has therefore attracted the attention of sanitarians for some time past, but up to the present little, if anything, has been done looking towards a satisfactory solution of the problem. At the same time the methods adopted for the purification of the water supply have been not less numerous, and several have been tried in actual practice—among them æration. It is doubtful, however, whether the results thus far obtained justify the expectations with which they were hailed, so that there still remains a wide field open for improvement.

It was a condition of affairs similar to that outlined above which for some time has caused much uneasiness to the inhabitants of New York City, and the local medical authorities, at the head of whom is Dr. Cyrus Edson, have been unceasing in their efforts to devise means for improving the condition of the water supply of New York City. One



THE WOOLF ELECTRICAL DISINFECTING PLANT AT BREWSTERS, N. Y.

of its chief sources of pollution was found to be the sewage outlet at the village of Brewsters, a little town situated some twenty miles from New York. At this place the sewage drained into a stretch of marsh situated at an elevation, and so located that the percolation reached one of the streams forming the water supply for New York City. These marshes had in themselves already grown to be a nuisance and a menace to the health of the inhabitants of the town, and hence the local authorities were also greatly interested in any means which would afford them relief. On looking up various methods with this end in view Dr. Edson decided that the simplest way out of the difficulty was the thorough purification and rendering harmless of the Brewster sewage; but the difficulty of effecting a thorough purification with the means ordinarily employed for that purpose involving the use of expensive chemicals containing hypochlorites and chlorides led him to the adoption of a method proposed by Mr. Albert E. Woolf of this city.

Mr. Woolf whose work in storage batteries has already been mentioned in these columns has recently developed a method of obtaining a cheap disinfectant by electrolyzing sea water. The principal solids held in solution in sea-water in the Atlantic Ocean are the following; the figures denoting parts in 100.

Chloride of Sodium	2.7558
Bromide of Sodium	0.0326
Sulphate of Potassium	0.1715
" " Lime	0.2046
" " Magnesia	0.0614
Chloride of Magnesia	0.3260
Total	3.5519

By passing a current through the sea water the chlorides, bromides, etc., are converted into hypochlorites, hypobromides, etc., and other compounds of a more or less complex nature are formed. When a solution of hypochlorite of sodium is brought into contact with organic matter, a decomposition at once takes place. While it is impossible to state just what the reaction would be, it is probably as follows: Part of the chlorine in the hypochlorite replaces a part or the whole of the hydrogen in the organic substance; another portion unites with the liberated hydrogen, and, as in bleaching, ozone is produced, which, in its turn, acts on the organic matter. In other words, the organic material, be it organized, as in the lower forms of vegetable life (viz., bacteria, etc.), or non-organized, as in the solid or suspended matter of sewage, is decomposed, and if sufficient hypochlorites be present the organic matter is permanently disinfected.

In the preparation of the Woolf disinfecting material it is, of course, essential to employ electrodes which are not decomposed by the electrolyzing action, and for that purpose Mr. Woolf employs a positive electrode consisting of copper coated with platinum; while as a negative he employs carbon.

As already remarked, the plant for the production of the new disinfectant has been established at the town of Brewsters, and our engraving shows the interior arrangement. It consists of a steam plant operating a Zucker & Leavitt dynamo which is capable of furnishing 700 amperes at a potential of 5 volts. The engine has a capacity of 15 h. p. Close beside the dynamo is an electrolyzing tank which has a capacity of 1,000 gallons and which is fed from a 3,000 gallon storage tank beside it, and elevated above it so that the solution flows to the electrolyzing tank by gravity.

The electrodes which rest on the bottom of the tank are composed of three platinum plates of the nature described above, and four of carbon, the positive and negative plates alternating. The carbon plates present a surface of 12 by 12 inches and are one inch thick. The arrangement as will be seen is such that the process is a continuous one. The flow of the solution is so timed that the salt water is electrolyzed to a proper degree, and then overflows directly into a pipe leading into the sewer.

This plant of 15 h. p. capacity is far in excess of that required to disinfect thoroughly the entire sewage of the town of Brewsters, but was designedly arranged so that it would eventually be able to take care of an increase of population amounting to 30,000.

The effect of the electrolytic disinfectant on the sewage outlet at Brewsters is of a most marked character. The offensive odors arising from the marshes no longer exist and the sewage shows a marked diminution in the nitrites present. It is also noticed that the green algæ and other organic matter, upon the surface of the marshes, and which had usually collected on the retaining walls has become bleached.

As showing the value of this electrical disinfectant produced by the aid of electrolysis, it is interesting to note some recent reports made by the officers of the Health Department of New York City. Dr. Cyrus Edson, chief of the medical staff of the Board of Health, states that in a series of experiments on anthrax spores and staphyloccus pyogenous aureus, in all cases save the exposure of anthrax for one minute to a 10 per cent. solution, the liquid exercises a marked inhibiting effect on the growth of the micro-organisms employed. It has also been shown that the solution is an effective agent for the destruction of cholera spirillum. Experiments made show that no cholera colonies are developed after an exposure of 30 seconds to the disinfecting agent. Tests of the Woolf disinfectant show that it equals in strength a 1 per cent solution of chloride of lime. In the latter there are 175 grains of available chlorine to the gallon while in the Woolf disinfentant 186 grains were found to be available.

In the matter of cost, however, the great value of the Woolf disinfectant will be apparent when it is considered that a 1 per cent. solution of chloride of lime costs about 1.4 cent per gallon with lime at 6 cents per pound. The estimated cost of the electrolyzed sea water, however, is only 10 cents per 1,000 gallons. Reckoning on this basis, therefore, Dr. Edson shows that its price per gallon may be .01 cent, in other words, 140 gallons of electrolyzed sea water will cost only as much as 1 gallon of a 1 per cent. solution of chloride of lime. Comparing the cost with that of bi-chloride of mercury, the disproportion is in the ratio of 100 to 1 in favor of the Woolf disinfectant; while a 5 per cent. solution of carbolic acid would cost from two to three hundred times as much; besides this, the two latter are extremely dangerous when handled by inexperienced persons. From this standpoint, electrolyzed sea water is harmless; indeed, we have seen the inventor drink it as one would spring water, without any apparent ill effects. The experiments made thus far have been so successful that Dr. Edson has recommended that steps by taken to locate a disinfecting plant in New York City, and no doubt the plan will soon be carried out.

THE POLARIZATION OF MELTED ELECTROLYTES.

The results obtained by Blondlot in his extensive research on the capacity of polarization have been confirmed by some recent experiments of M. Bouty (*Proceedings* of Société Française de Physique). M. Bouty has chiefly studied the case of melted electrolytes, of extremely dilute solutions of salts and of solid electrolytes, and his results have very conclusively shown that the initial capacity of polarization (K) is independent of the direction of the polarizing current. When a platinum electrode has been immersed in a melted electrolyte for 24 hours it possesses, for a given temperature, a constant initial capacity of polarization, which increases rapidly with temperature, while the maximum polarization decreases. In the case of electrodes of platinum in concentrated solutions of most salts (those of platinum excepted) the value of K is very nearly the same for all, and varies little on account of dilution, while there appears to be no connection between the value of K and the specific resistance of the solution.

THE EVOLUTION OF ONE CURRENT "RECTIFIER."

BY

Wm. Maver, Jr.

It has occurred to me that it might be interesting to some to follow a short description of the inception, develop-

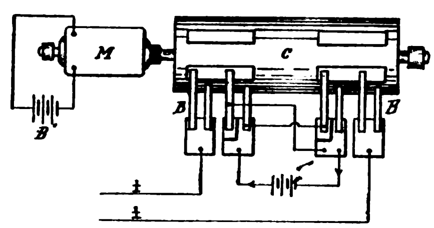


FIG. 1.

ment and relapse into desuetude of a, more or less, simple device for translating alternating currents into straight currents. The narration will doubtless amuse those who themselves have had analogous experiences and may be suggestive in a small way to those who have not as yet attempted to exercise their inventive faculties.

When I was preparing a diagram to illustrate the transmitter, an instrument used in the "Gold and Stock" printing telegraph system, and shown in Fig. 1,—in which a straight current is made alternating by means of a pole-changing device, consisting of a set of brushes B B and insulated segments on the cylinder C,—it suggested itself to me that by a reversal of this arrangement an alternating current could be made a straight one, and, in view of the fact that such a device, if simple and efficient, would find a large market, I set about designing the necessary connections.

It was, of course, essential that power should be provided to turn the cylinder at a rate corresponding with the alternations of the current. Fig. 2 shows the first arrangement devised. A motor M at the left of the cylinder C was to be the turning power and a relay M', with its coils in the

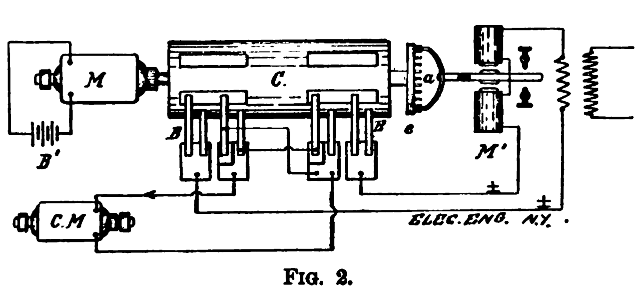


FIG. 2.

alternating circuit, was to be caused to regulate the speed of the cylinder in a way that will be obvious, by means of its armature, to which an anchor *a* playing into an escapement *e*, was attached. As there would have been difficulty in starting the motor by means of the alternating current, and, of course, an alternating current would flow through the motor circuit while the cylinder was stationary, a special battery B' was provided. But it was my intention to disconnect this battery automatically as soon as the cylinder was fairly started.

Theoretically, I supposed, this arrangement would operate, but it was clear that the use of the motor to drive the cylinder was a drawback. A driving spring or weights to turn the cylinder mechanically were also thought of, but abandoned as likely to prove bothersome.

To avoid the need of a motor and also to further simplify

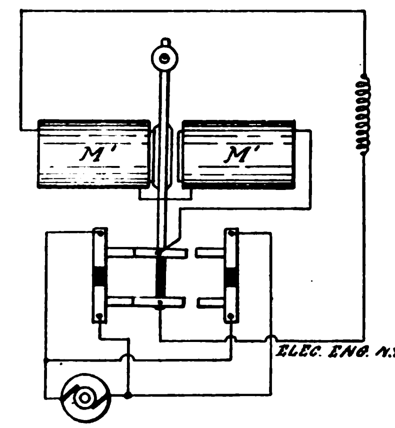


FIG. 3.

the arrangement by dispensing with the cylinder, the plan shown in Fig. 3 was thought out. In this the armature of the polarized relay M' was caused to carry reversing strips and thus, as it oscillated in response to the currents passing in the coils of M', the current was to be straightened out.

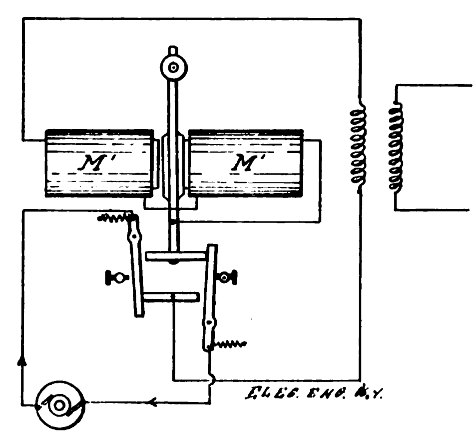


FIG. 4.

This also was considered likely to prove of doubtful utility in practice, and it was thence but a step to the device shown in Fig. 4, in which the armature lever of the relay is supplied with contacts similar to those employed in the

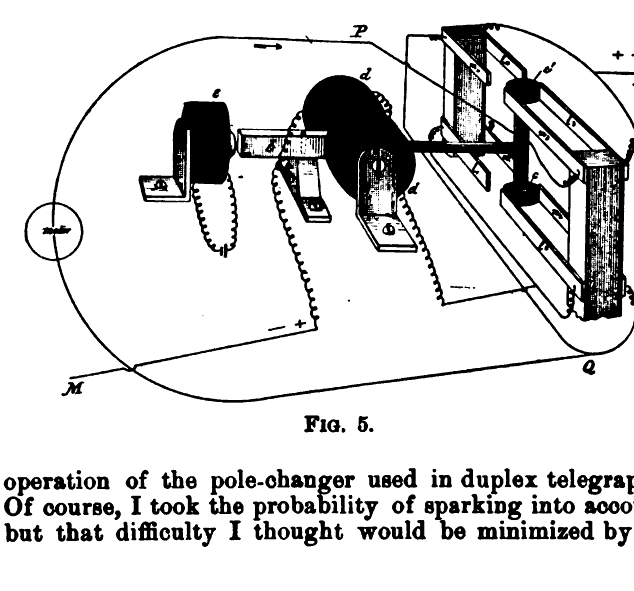


FIG. 5.

operation of the pole-changer used in duplex telegraphy. Of course, I took the probability of sparking into account, but that difficulty I thought would be minimized by the

use of non-arcing metal and suitable contact points, and, possibly, condensers.

The manner of operation of this "current rectifier" will be obvious to those who are familiar with the ordinary duplex pole-changer. In that instrument a "straight" current is reversed by the movement of the contact points. In the case under description the connections of the pole-changer are just virtually reversed and as the alternating current to be straightened regulates the motion of the current straightener I supposed that by proper adjustment of the contact points the current in the motor or straight current circuit would be practically continuous.

At all events the device had reached a stage where I deemed it time to test its patentability and with that object in view I filed an application for letters patent. The result was that a reference was returned in which the device seen in Fig. 5 was disclosed. It will be noticed that it is somewhat akin to the device shown in Fig. 4. As a patent had been issued some years previously for the device shown in Fig. 5, the application for the former device was not vigorously prosecuted.

A STUDY OF THE SOURCES OF ELECTRICAL ENERGY.[1]—I.

BY

Francis B. Crocker

THE source from which to obtain electrical energy is obviously a matter of prime importance. It is, however, a most difficult problem and one which is undergoing great change and progress at the present time. The difficulty of the problem is increased by the fact that it involves some of the deepest principles and finest points in mechanical and electrical engineering, and chemistry also, being, as it were, on the border line between these great branches of applied science.

The interest and importance attached to this subject makes it worth while, therefore, to carefully consider and compare the various methods of generating electricity, including not only those which are already in common and successful use, but also possible methods, even though they be not yet practical. These may be arranged as shown in the accompanying table:

POSSIBLE METHODS OF GENERATING ELECTRICAL ENERGY.

Natural Sources of Energy.	Used in following apparatus	Produce.	Used in following apparatus	Produce.
FUEL including coal, oil, natural gas, wood, HEAT OF SUN, HEAT OF EARTH	Voltaic battery	Electrical energy		
	Metallurgical apparatus	Zinc or other metal	Voltaic battery	Electrical energy
	Thermoelectric battery, Thermomagnetic generator	Electrical energy		
	Steam engine, Gas engine, Hot air engine	Mechanical energy	Dynamo, Electrostatic machine	Electrical energy
WATER,	Water wheel			
TIDES,	" "			
WAVES,	Wave motor			
WIND,	Windmill			
ANIMAL POWER,	Treadmill or crank			

This table shows the natural sources of energy that are at all available, all of which, with the exception of the power of the tides and the internal heat of the earth, are derived from the radiant energy supplied to the earth by the sun. Of these possible sources only two—fuel and water power—are now used to any extent to produce electrical energy or, indeed, any other form of energy for any purpose requiring considerable power.

For various reasons, chiefly unreliability, the other sources are not practical.

Animal Power can be used to generate electrical energy, as in the case of a small dynamo driven by hand, but the power is very small. Even a strong horse working in a treadmill could hardly drive a dynamo of sufficient capacity to supply 10 ordinary incandescent lamps. In short, animal power is obviously inadequate for heavy work. Nevertheless, the electrical engineer is not in a position to speak contemptuously of animal power since it is only within a very few years that electric power produced by the best methods has been able to even compete with horses in the propulsion of street cars.

Wind Power is cheap and simple in itself, but it is proverbially unreliable and unsteady and therefore requires the use of storage batteries and rather complicated automatic devices for connecting the windmill, dynamo and storage battery. Mr. C. F. Brush has for several years had a wind power electric plant in his private grounds at Cleveland, O.[2] A recent article gives data of construction, cost and operation of a number of such plants.[3] Wind power is perhaps admirably suited to small private plants, but it can hardly be hoped to use it for large commercial works.

Wave Power is of course primarily derived from the wind, but it is not quite so unreliable or unsteady. There are, however, great difficulties in its use. It is not practicable to drive a dynamo directly by a wave motor. It would be better to pump water to a reservoir and run the dynamo by a water wheel, but it is very doubtful if any such plant would be at all satisfactory.

The Power of the Tides is really due to the energy of rotation of the earth on its axis and, theoretically, any resistance to the flow of the tides produces an infinitesimal slowing down of the earth. Tide power is almost the only natural power not derived from the sun. It is more practical than wave power. The usual way of obtaining it is to allow the water to run into a pond at high tide and when the tide begins to run out, a gate automatically closes. When the water level outside falls a sufficient amount, the water in the pond is allowed to flow out and to operate a turbine wheel which drives a dynamo.

This power is much less liable to fail than ordinary water power, being nearly constant throughout the year, except that ice would be apt to cause trouble. The disadvantages are that the turbine can only be run twice in

1. Extract from a forthcoming treatise on Electric Lighting, by the same author.

2. THE ELECTRICAL ENGINEER, Dec. 24, 1890.

3. Wind Mills for Electric Lighting, G. H. Morse, *Elec. World*, June 10, 1893.

the 24 hours for about four hours each time, and the times of these periods change with each day. This would necessitate the use of a storage battery.

It is evident that this power is only available on the sea coast and then only at places having a large rise and fall of tide, which must be at least six feet and should be 10 or 12, since the average head is considerably less. Prof. Elihu Thomson, we believe, has a plant of this sort at his residence in Swampscott, Mass. It is not likely that this source of energy will ever be largely used except in certain localities for small amounts of power.

Water Power is, as already stated, one of the two great sources of power used for large and important work. It is very simple in principle and involves no very difficult theoretical or practical questions. The evaporative action of the sun lifts up, so to speak, the water which afterward condenses and falls as rain upon the land, and in running to the sea in the form of rivers or streams it is capable of giving mechanical energy in proportion to its weight and the height through which it descends by passing it through a turbine or other form of water wheel, which in turn drives a dynamo that generates electricity. Water power possesses the advantages of simplicity and cheapness, but it has the disadvantage of liability to fail during droughts in summer and is subject to troubles from ice and floods in winter and spring. Water power is usually not so cheap as is supposed, largely because of its unreliability, and frequently steam power is preferred even where water power is available. The amount and accessibility of water power is somewhat limited, and with the exception of Niagara Falls most of the water power in the thickly settled parts of America and Europe is already used.

For example, the water power at Holyoke, Mass., Rochester, N. Y., and Paterson, N. J., which are about the largest in their respective states, are already nearly all used. Some countries like Switzerland have more than enough for their needs, but others, like England, have practically none. The long-distance transmission of electrical energy from enormous water powers like Niagara will tend to overcome this limitation. But it is a question even then whether electric power from Niagara can be supplied in New York City, for example, as cheaply as steam power. We are now on the eve of an extensive trial of a great experiment at Niagara which will probably be successful, but will not, after all, greatly effect the question of power for the country at large.

The Heat of the Sun is a source of energy of enormous quantity, the total heat received per annum from the sun by the earth being equivalent to the combustion of a layer of coal eight inches thick covering the entire surface of the globe. A large part of this heat is, however, intercepted by clouds and the atmosphere. Moreover the heat requires concentration or accumulation in order to develop any considerable power, the average quantity of heat received per square yard upon a clear day being equal to about one horse power. Ericsson and others have focussed the sun's heat by lenses or mirrors and operated engines of a few horse power. This source of energy has the insuperable difficulty of being interrupted by cloudy weather for weeks at a time. If this heat were employed to operate steam, gas or hot air engines or thermoelectric or thermomagnetic generators, the case would be very similar to the use in these apparatus of the heat obtained from fuel, which will be discussed later.

Heat of the Earth.—This is also a possible source of energy of vast quantity. It manifests itself naturally in the case of thermal springs, volcanoes, etc. It is made evident artificially in deep mines and oil wells. It cannot be said to be a practical source of energy at present, but it is by no means impossible that deep holes might be bored in favorable localities for the express purpose of obtaining heat from the earth. To obtain mechanical or electrical power from this heat would, as in the case of the sun's heat, be a matter similar to the utilization of the heat of fuel, which is the next subject to consider.

Fuel.—The use of fuel in the production of electrical energy is one of the most momentous and difficult problems presented to the human mind. Even a fairly satisfactory solution of it requires the employment of some of the most important principles in science and engineer ng, and has a very great effect upon civilization. A very satisfactory solution of this grand problem is the hope and aim of many of the greatest living men of science and its probable effect would be to revolutionize present methods in agriculture, mining, manufacturing, commerce and even domestic economy.

The energy in fuel manifests itself in the form of chemical affinity, that is, the atoms of carbon and hydrogen of which it is composed have a very strong affinity for oxygen and under proper conditions combination takes place and the chemical energy possessed by the fuel is converted into some other form of energy, usually that of heat. This energy in the fuel is latent or potential energy similar to that of a stretched spring which is entirely inactive until it is released. In fact carbon is one of the most inert of all substances at ordinary temperatures, and will exist without sensible action or change for centuries. This potential energy of fuel is stored in it by the action of the sun's rays upon plant cells in which carbon dioxide is decomposed, carbonaceous material being formed and oxygen set free. This carbonaceous material can be used immediately as fuel, as in the case of wood, or it may be converted into peat, coal, etc., by long-continued natural processes.

The ordinary method of obtaining energy from fuel is that of combustion which consists in causing the carbon to combine with the oxygen of the air, producing carbon dioxide again and generating an enormous amount of energy in the form of heat. This combination does not ordinarily take place except at a high temperature, usually about a red heat, which is the condition necessary for the action.

The heat energy produced by combustion can be applied in various ways to produce mechanical or electrical energy, the most common method being to cause it to evaporate water in a boiler, the steam produced being used in the cylinder of a steam engine to move the piston and produce mechanical power. In the gas engine the fuel in the form of gas (which may be either natural gas or some liquid or solid form of fuel previously converted into gas) is caused to combine with the oxygen of the air directly in the cylinder of a suitable machine, the combined gases being raised to a high pressure by the combustion, thereby actuating the engine. These and other similar forms of machine are called heat engines, and with the exception of water wheels they are practically the only prime movers or original sources of power used for generating electrical energy or for any other useful purpose, and they have contributed more than any other factor to modern civilization.

Nevertheless there are certain inherent theoretical and practical difficulties which apparently leave much room for radical improvement in the production of mechanical and electrical energy from fuel. In the first place the method now ordinarily employed to generate electricity is very roundabout. It consists first, in burning coal under a boiler; second, evaporating water in the boiler; third, conveying the steam to the cylinder of the engine; fourth, allowing the steam to expand and move the piston; fifth, transmitting the motion of the piston by means of mechanism to produce rotation of the shaft of the engine; sixth, causing the rotation of the dynamos by mechanical connection with the engine; seventh, generating electric currents in the dynamo by revolving conductors in a magnetic field. Thus we see there are seven distinct steps in the process of generating electricity for which three large and expensive pieces of apparatus are required, viz., boiler, steam engine and dynamo, each of which has a great many parts and requires considerable attention, and these three main pieces of apparatus have to be connected together by piping, mechanism, etc., which still further complicate the plant.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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ELECTRICITY AND SANITATION.

THE introduction of the electric light has already contributed not a little to increased comfort and improved sanitary conditions in dwelling houses and public places, while the introduction of the electric motor has already begun to have a marked effect on the condition of everybody brought within its influence. This advance includes not only the improved condition of shops driven by electric motors, but the electric railway which enables the workman to select a home in the outskirts of the town, where formerly he was obliged to live in a closely-packed tenement. But electricity, it would appear, is destined in other ways to exert a marked influence on public sanitation in general, as will become apparent upon a perusal of the description, given elsewhere in this issue, of the disinfecting plant now in operation for the purpose of purifying the water supply of New York City.

It is strange indeed that such an enormous supply of salts as that afforded by the water of the sea should have so long been overlooked until taken up recently by Mr. A. E. Woolf, who electrolyzed the water for the purpose of obtaining the compounds known to have a powerful destructive effect on organic matter. The low cost at which the Woolf disinfectant can be obtained makes it certain, we think, that it will in time displace all other types of disinfectants for general use. We hope we will not be accused of using these columns for the undue commercial advancement of any object, but simple justice leads us to state that we have tried the powers of the Woolf solution in a number of instances and have found it to possess most remarkable qualities. Our article descriptive and illustrative of the method of purification employed at Brewsters shows that a plan has been hit upon which ought to be tried most thoroughly by all large communities situated as New York is with a water supply to be kept pure at all hazards and at any cost.

THE BERLINER TELEPHONE PATENT.

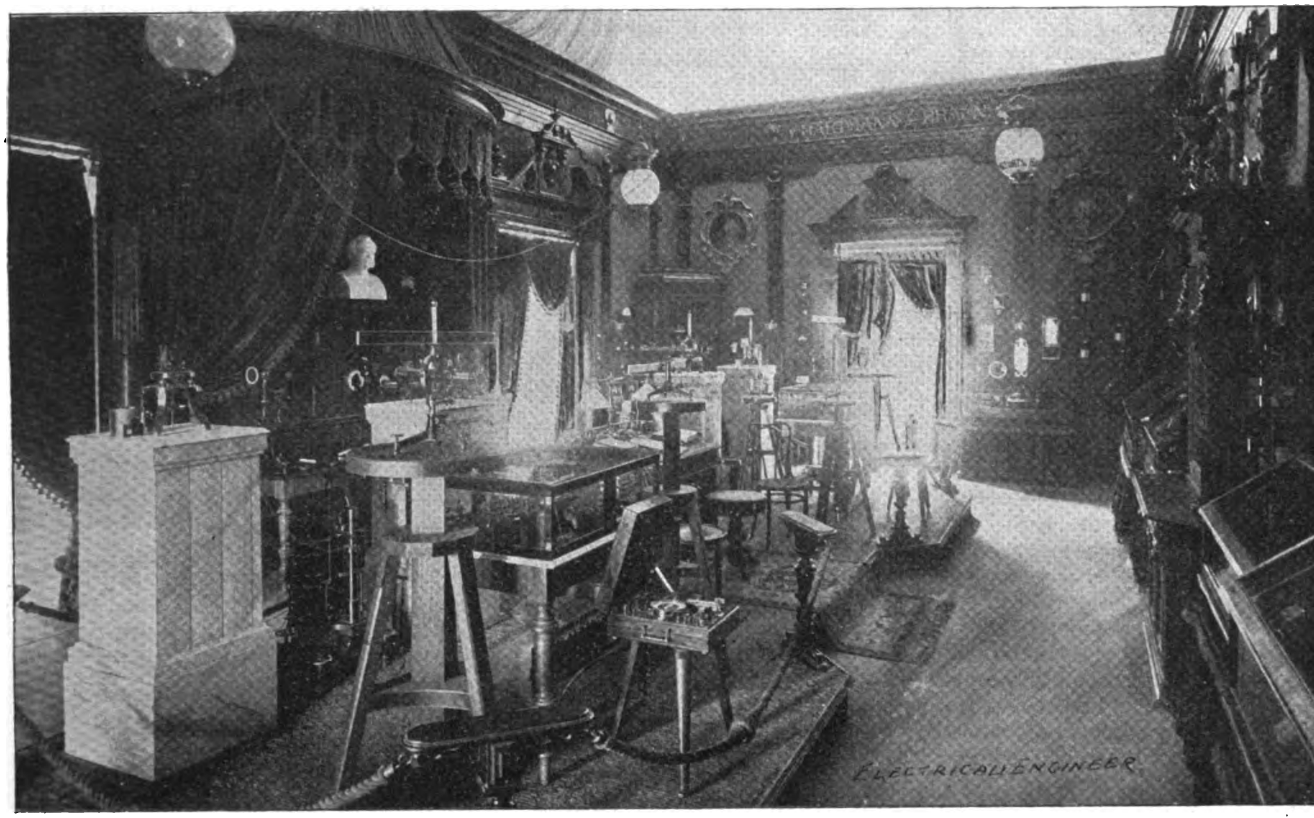
NOT much has been heard recently of the Government suit to annul the Berliner microphone patent. It is quite certain, however, that the case will not run on undetermined for seven or eight years like the old and still unsettled suit to cancel the Bell patent of 1876. It is evident that the American Bell Telephone Company has a stronger motive for seeking dispatch than for securing delay this time. The Berliner patent is on a very different footing from that occupied by the Bell patent when it was attacked by the Department of Justice. That patent had been very thoroughly adjudicated and upheld by the courts, and the Government suit went harmlessly on its leisurely course during the remaining life of the patent (and still goes on although the patent is some months dead), forming no obstacle to the issuance of injunctions against infringers. But the Berliner patent, which on its face seems fundamental in respect to nearly all existing forms of microphone transmitters, has not yet had the judgment of any court as to its scope or validity. In its first ordeal it is put upon its defense under the attack of the Attorney-General. It is, therefore, not at all likely that its owners, the American Bell Telephone Company, will institute any infringement suits until it knows whether or not it has a sound patent. A court would hardly take time to go into the question of infringement under the present circumstances of the patent. Moreover, the exceptional control of an entire art enjoyed by the Bell Company for seventeen years, because of the unprecedented scope of the Bell patent which would have protected it against the use of the Berliner invention had it been in other hands—would probably be deemed by any court of equity a good reason for turning a deaf ear to any plea of urgency on the part of the Bell Company in dealing with an alleged infringer.

It is understood that testimony is now being taken in the Government suit and we have no doubt that any unnecessary delay in pushing the case to a conclusion will be chargeable to the Department of Justice rather than to the defendant.

COMPETING LIGHTING COMPANIES NOT ALWAYS DESIRABLE.

WE note in other columns of this issue, the decision of the Massachusetts Board of Gas and Electric Light Commissioners, revoking the franchise granted last year to the Quinsigamond Electric Power and Light Company, and quote at some length the language of Commissioner Barker who wrote the decision. The reasons therein assigned for leaving the Worcester Electric Light Company in possession of the field during good behavior are worth pondering by municipal authorities, consumers, promoters, and even by manufacturers and sellers of lighting apparatus. It would be well if many other states possessed Commissions like that of Massachusetts to regulate the business of lighting and to determine issues between established companies and would-be rivals.

WORLD'S FAIR DEPARTMENT.



HARTMANN & BRAUN EXHIBIT OF ELECTRICAL TESTING INSTRUMENTS AT THE WORLD'S FAIR.

HARTMANN & BRAUN INSTRUMENTS IN THE GERMAN SECTION.

MENTION has been made from time to time in the course of these articles of the excellence of the German exhibits both in regard to matter and arrangement, but owing to the backwardness of the work very little has been said of any one display. It is gratifying, therefore, to be able at last to describe in detail one of the most interesting branches of German work, as represented by Hartmann & Braun's exhibit of electrical measuring instruments. This

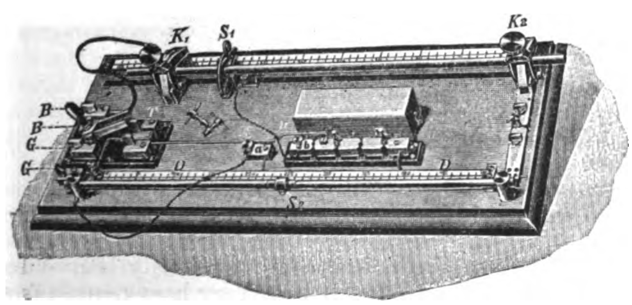


FIG. 1.—LOW RESISTANCE BRIDGE FOR DETERMINING SPECIFIC RESISTANCE.

firm, of Bockenheim, Frankfort-on-the-Main, occupy a separate room at the exit of the German Division on the ground floor of Electricity Building. This rooms contains a fully equipped laboratory in working order, for electrical research, a central lighting station, a collection of measuring apparatus for workshops, electrical fitting and cable laying, including ammeters, voltmeters, resistance boxes and measuring instruments for continuous and alternating currents, and finally a collection of electrical and magnetic instruments of precision.

In the centre of the room stand a number of appliances for measuring resistances, current and E. M. F., some of

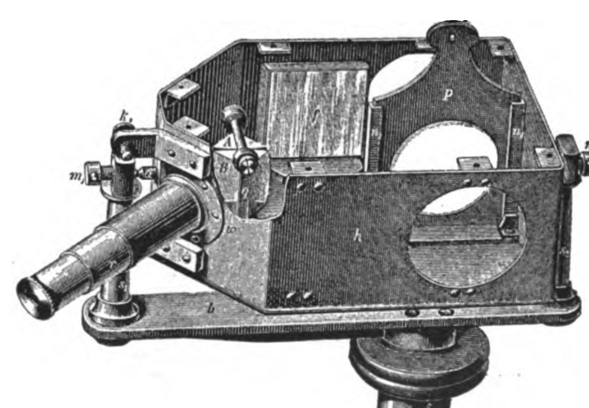


FIG. 2.—LUMMER-BRODHUN PHOTOMETER SET.

which are especially interesting. One piece of apparatus for determining the strength of a current by the compensation method consists of a Clarke standard cell and balance resistance, a resistance box for the main and shunt circuits, a branch resistance of .01 ohm and an aperiodic reflecting galvanometer with a Siemens bell magnet and

reading telescope. Near this is an instrument for measuring high insulation resistances, employing an astatic cable galvanometer, Bruger's magnets and several shunt resis-

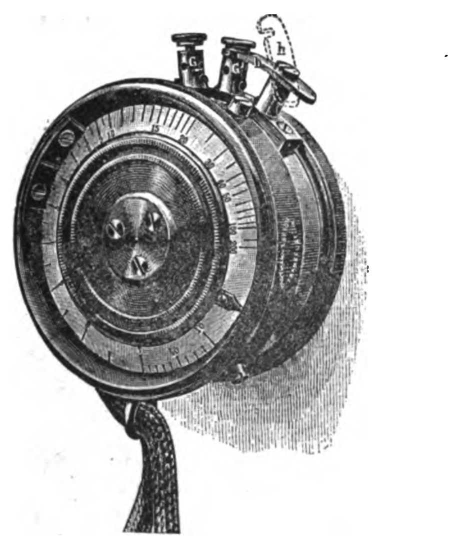


Fig. 3.—Nippoldt Telephone Bridge.

tances, a scale lamp for objective reading, a megohm with ten subdivisions as a standard of comparison, a battery of dry accumulators with a universal pachytrope and the necessary switches. An apparatus for measuring the capacities of cables is also shown. The reflecting galvanometers of these instruments stand upon brick piers, while the optical reading appliances belonging to them are mounted on adjustable Gauss stands.

In Fig. 1 is shown a low resistance bridge for specific resistance. As will be seen, the instrument is a modified Wheatstone bridge in which the resistances of the contacts are eliminated by taking double readings. Two universal adjustable clamps K_1 K_2 grip a certain section of the rod or wire to be measured. A sensitive galvanometer is coupled at G G and the battery at B B. Two of the bridge plugs

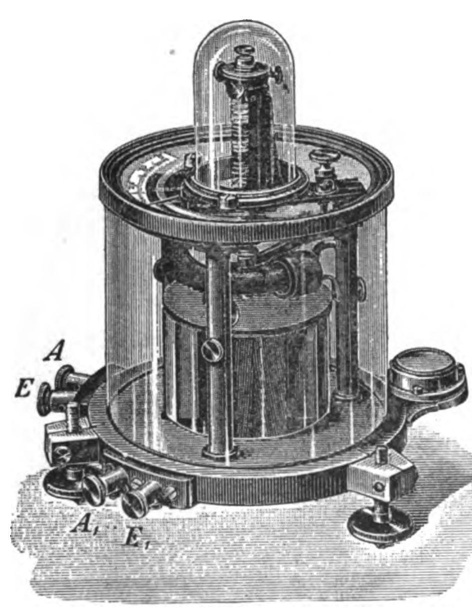


Fig. 4.—Wattmeter for Continuous and Alternating Currents.

are then withdrawn and the movable contact S_1 is brought first near K_1 and then near K_2, the contact S_1 being adjusted until the galvanometer is no longer affected by opening the switch. The resistance of the piece of wire between the two positions of S_1 is thus measured by a comparison of the fall of potential with the fall of potential over the calibrated wire. Here is also an apparatus for testing the magnetic permeability of iron and steel, by means of a standard electromagnet and a Lenard's bismuth spiral. The strength of the magnetic field is determined by a bridge with an ammeter and a galvanometer constructed on the Deprez principle. A Kohlrausch apparatus for determining the resistance of electrolytes is shown consisting of a Kirchoff-Wheatstone bridge of cylindrical form, an induction apparatus for generating alternating currents,

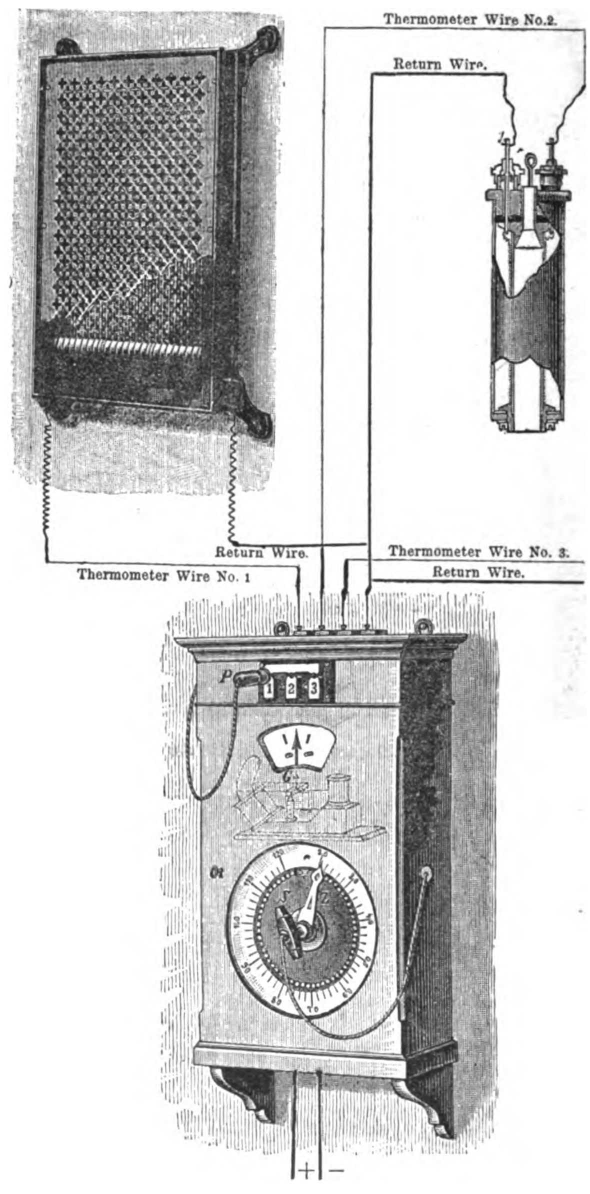


Fig. 5.—Hartmann & Braun Telethermometer.

a unifilar suspension electrodynamometer, a telephone, three U-tubes with platinum electrodes and an Arrhenius resistance vessel.

At one side of the room is an ingeniously improvised dark-room, consisting of a pair of very heavy curtains so hung that they may be drawn together in a wide semicircle, excluding the light sufficiently for photometric work. This space is occupied by a photometric apparatus consisting of a large precision photometer with a Lummer-Brodhun comparison prism, a standard amylacetate lamp, a universal incandescent lamp stand, a revolving mirror for determining the illuminating power of arc lamps at various angles, and the necessary ammeters and voltmeters. The photometer box is shown in Fig. 2. The table consists of

two pairs of rods, each five feet long, so arranged that they may be connected and the total length increased to 10 feet, accurately divided into centimetres.

Among the smaller appliances forming part of the exhibit may be mentioned several resistance bridges reading directly, without calculation; differential galvanometers; a Nippoldt telephone bridge for testing the earths of lightning rods, consisting of a Wheatstone bridge, arranged in a clock-shaped case, Fig. 3, to protect the calibrated wire, the sliding contact being adjusted by the circular motion of the bezel; tangent galvanometers; silver and copper voltameters, and also a Kohlrausch water voltameter; direct reading aperiodic torsion galvanometer ranging from one to 100-fold, and torsion electro-dynamometers and wattmeter for continuous and alternating currents, one of which is shown in Fig. 4. The indications of this instrument are based upon the movements produced by a solenoid acting upon a double rotating solenoid with similar outer and inner poles thus: N S—S N. The direct reading scale has nearly proportional divisions, and this, together with the range of from one to 100-fold measurement, the damping

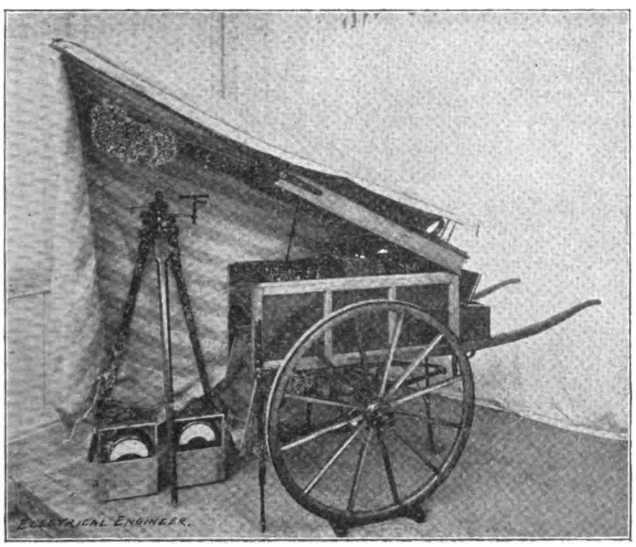


FIG. 6.—PORTABLE CABLE TESTING SET.

arrangement, and the absence of magnets or iron parts renders it particularly valuable as a calibrating instrument.

A Braun pyrometer, for temperatures up to 1,500 degrees Centigrade is shown, in which the temperature is measured by the variation in resistance of a platinum wire wound inside of a non-combustible box and forming one side of a Wheatstone bridge. This instrument is standardized with a porcelain air thermometer and its accuracy is very great. Another interesting temperature-measuring instrument is the telethermometer shown in Fig. 5. The metal thermometer is enclosed in a metal case, and the indicator consists of a very sensitive galvanometer and a resistance bridge arranged in an oak case to show the index. The resistance is adjusted from without and the temperature is read directly. In use the loose key S is inserted in the hole at the centre of the scale switch and the pointer is turned over the small contacts until the galvanometer needle comes to zero. The apparatus shown in the figure has 50 contacts for temperatures between 20 and 120 degrees, reading in steps of two degress. There are three thermometers with a plug board and plug P for putting any one of them in circuit. The leads have cross-sections of 1.5 or 2 sq. mm. and great differences in length are compensated for by the insertion of artificial resistances in the other circuits beyond the plug board.

In a large case at the right of the entrance as one enters are Kohlrausch measuring apparatus of all kinds, while at the left hand are standards made according to those in the possession of the Imperial Physical and Technical Institute at Charlottenburg. In other cases and about the walls are ranged most of the other instruments made by the firm; galvanometers, reading telescopes, lamp stands and scales, rheostats for scientific and industrial measurements, bridges, school laboratory instruments, voltmeters and ammeters for large currents, direct and alternating, wattmeters, ohmmeters, coulombmeters, cut-outs, regulators, switches, lamps and small portable motors and generators. Just outside the entrance stands the portable measuring apparatus for cable testing, shown in the engraving, Fig. 6. This is a two-wheeled truck furnished with a resistance bridge, an apparatus for testing insulation resistances by the deflection method, and a tangent galvanometer. The galvanometer stand is carried in a space underneath. A measuring battery of 100 dry accumulators with a pachytrope for selecting various voltages, and a controlling voltmeter and ammeter complete the apparatus.

It is impossible to give an exhaustive account of all the appliances included in this exhibit, but those touched upon and illustrated will give a good idea of the scope of the work carried on by the firm. Everything shown is of their own manufacture, and, taken altogether, makes an imposing display. The pavilion, besides, is very handsomely finished and decorated both inside and out, and compares creditably with the rest of the exhibits in the German section, all of which show more than ordinary care and taste in design and execution.

THE EDISON EXHIBIT OF THE GENERAL ELECTRIC COMPANY.

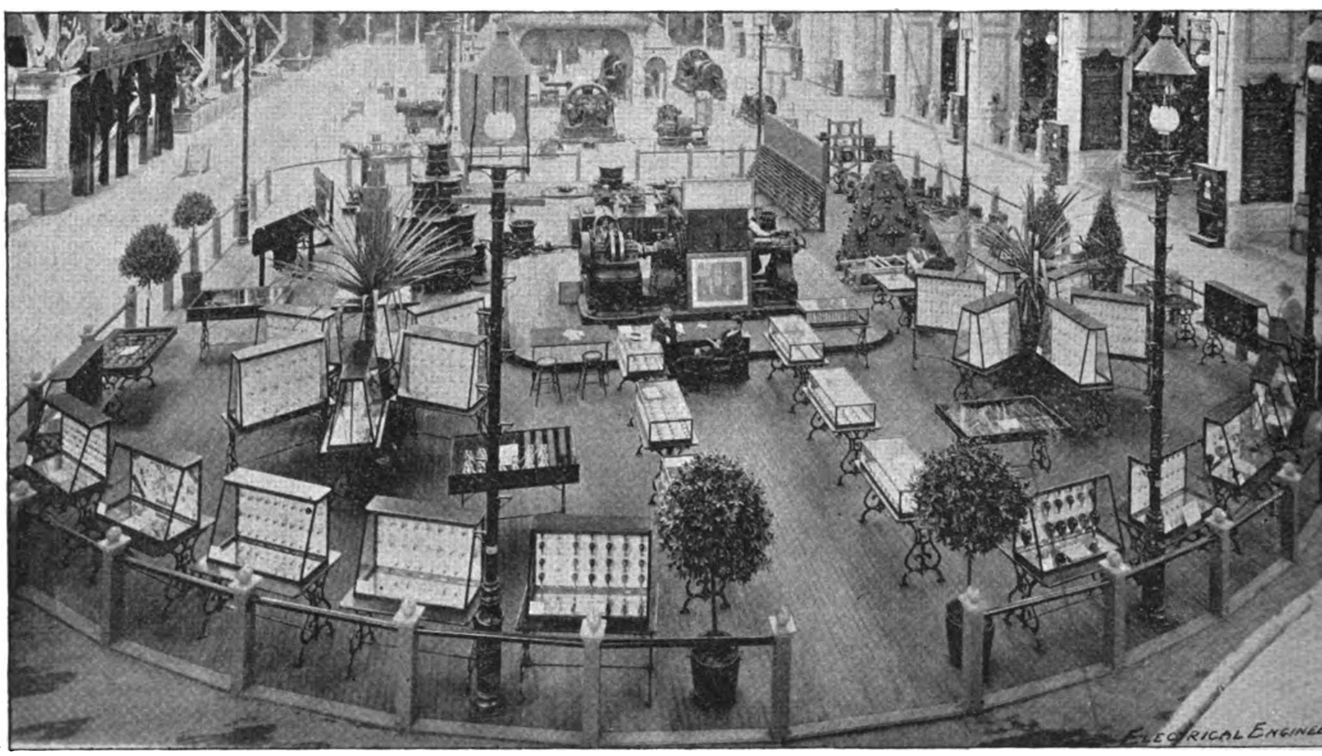
It will be remembered that the principal part of the General Electric Company's exhibit in Electricity Building occupies the four large spaces surrounding the central tower where the apparatus is carefully classified under separate departments. The Edison part of the display,—that is, incandescent lamps, generators and motors of the Edison type, the feeder and main system, etc.,—is shown in the engraving on this page and stands directly north of the tower. The most conspicuous single piece of apparatus in this space is "Jumbo," an account of which was given in THE ELECTRICAL ENGINEER of May 10, and around this historic machine as a centre cluster the more modern forms of electrical appliances.

About half of the section is taken up, as will be seen, with glass show cases containing specimens of incandescent lamps. There are 2,500 of these, no two alike, from the factory at Harrison, New Jersey. Among them are colored lamps for various purposes, lamps of special types, miniature lamps, and lamps of odd and fantastic shapes. The steps in the manufacture are shown, from the original glass tube to the finished lamp. There are "municipal" lamps for long distance, high voltage incandescent street lighting circuits; standard lamps of various voltages and of 10, 16, 20, 24, 32, 50 and 100 c. p.; experimental and historical lamps; special types of resistance lamps used by the Western Union Telegraph Company with several filaments in series and in multiple; railway lamps with anchored, unanchored and spiral filaments, etc.

In one case are shown the tools used by Mr. J. W. Howell during the great "Filament Suit" in making the "tar-putty" lamps described by Mr. Edison in his fundamental patent No. 223,898, and which his opponents declared could not be made. Two of the lamps made with these tools by Mr. Howell are also shown. Several other cases are filled with specimens of the vegetable substances that were experimented upon by Mr. Edison in his search for the best material for filaments. This investigation involved trips to all parts of the world and finally resulted in the selection of a certain kind of Japanese bamboo

that is now cultivated solely for this purpose on special plantations in Japan. The specimens are shown both in pieces directly from the plants and also as shredded fibre. Other cases contain filaments before and after carbonization.

Just beyond the lamps is a complete model three-wire system in operation, furnishing current to about 60 lights. A motor of 4 h. p. drives two 1½ k. w. generators from a small countershaft. The switchboard is provided with everything needed in the best equipped station,—motor, generator, and main line switches, starting boxes, rheostats, voltmeters, ammeters, ground detectors, etc. The current generated goes through regular street feeders, laid above the floor so that they may be seen, to junction boxes from which the covers have been removed, and thence through the mains to service. The entire system is in sight, from the motor to the lamps and gives a wonderfully good idea of the real thing; in fact it is



LAMP EXHIBIT OF THE GENERAL ELECTRIC CO., WORLD'S FAIR, CHICAGO.

the real thing itself on a small scale. Two boards, showing, respectively, the three-wire and the underground systems flank this model plant and contain feeders, mains and wires of the different sizes and forms used, and also the separate parts of the junction boxes, etc. A pyramid of junction boxes, eight, six and four way, occupies a position at one side, while opposite is another composed of connection boxes and their parts.

At the eastern side of the section, next the aisle, is shown the Western Union Telegraph Company's system of generators for the World's Fair service. An 8 h. p. 250 volt Edison motor running at 1,550 revolutions per minute drives a countershaft from which are belted four 150-volt generators and one exciter, the former running at 1,900 revolutions and the latter at 2,400. The switchboard is completely equipped with switches, meters, rheostats, starting boxes, etc., and contains a small central pressure board to which wires are run from all the generators and where any one may be switched into connection with the voltmeter at will.

At the opposite side of the space are the models used before Judge Green in the "Three-Wire Case," showing the amount of copper required to light the same space by the "tree" and "feeder" systems, respectively. Here are also cubes representing the relative masses of copper needed for the three-wire feeder, the two-wire feeder, the three-wire tree and the two-wire tree systems. In a case near these are seven volumes containing over 7,000 pages filled with the testimony taken in the Filament Case.

An interesting piece of apparatus is the first Edison generator ever built. This machine was made early in 1880, and is one of the 15 used at Menlo Park at the first public exhibition of incandescent lighting. Since then it has run continuously, most of the time at the lamp works at Harrison, and was taken from actual duty there to be shown at the Fair. This machine has already been described in these pages.

The exhibit, as a whole, is a very striking one, showing at a glance the state of perfection to which the art has been brought, and the study, experiment, struggles and successes of the man whose untiring perseverance was able to accomplish what had been deemed impossible by the highest authorities.

PREPARATIONS FOR THE INTERNATIONAL ELECTRICAL CONGRESS.

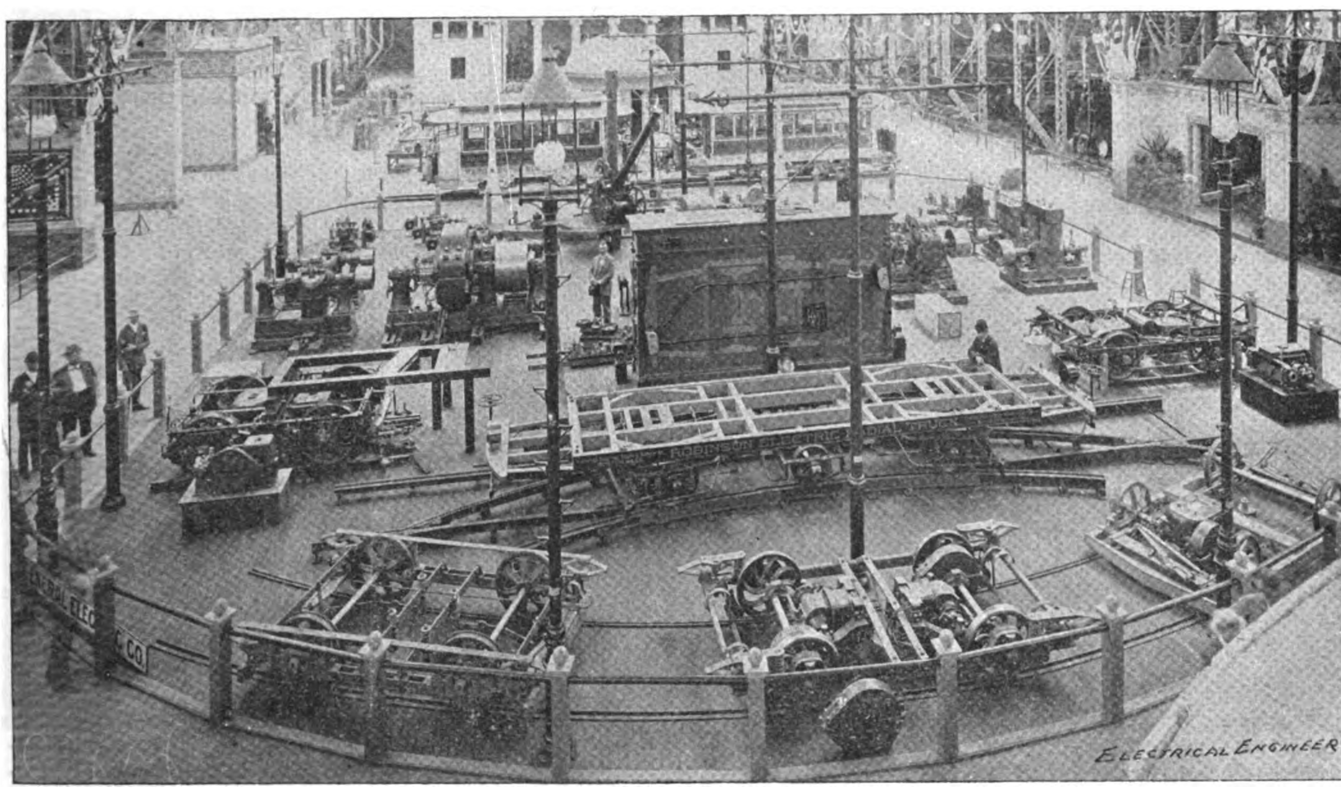
DR. ELISHA GRAY, president of the Advisory Council, has received a letter from Dr. von Helmholtz, announcing that he has been appointed by the German Government an official delegate to the International Electrical Congress and that he will take part in its proceedings. He will be accompanied by Drs. Feussner, Kurlbaum, Leman, Lindeck, Lummer and Pringsheim of the Reichsanstalt. These gentlemen have carried out electrical investigations on subjects to be treated officially by the Chamber of Delegates at the Congress.

Prof. W. E. Ayrton has arrived at Chicago from England and will remain there until after the Congress. Mr. E. Hospitalier has reached New York from France, and will proceed to Chicago by easy stages, arriving there in good time for the Congress. Both are delegates and are to present papers.

THE GENERAL ELECTRIC COMPANY'S RAILWAY AND MOTOR EXHIBIT.

On the opposite side of the central tower from the exhibit of Edison lamps and lighting, described in another article, is that of the railway and motor department of the General Electric Company. Of the apparatus seen here, none is especially new, but it is interesting nevertheless as showing the actual practice now existing on roads operated and equipped by this company. At the right of the space just back of the railing that separates it from the centre aisle is a Taylor truck equipped with two 15 h. p. waterproof motors and a Genett air brake. The truck is jacked up so that the wheels may revolve and the brake be shown in operation. It will be remembered that this device was described some months ago in THE ELECTRICAL ENGINEER. The air is compressed by means of an eccentric on the axle and after reaching a pressure of 32 pounds in the reservoir the pump is automatically cut out. An unmounted single reduction motor, of the class used almost universally Thomson-Houston type of 300, 200, and 100 kilowatts respectively, and extending back of these to the left and right are Thomson-Houston and Edison motors, eleven of each, the former from 75 to two h. p., and the latter from 60 to .5 kilowatt. The larger Edison motors have starting boxes of marble mounted on pedestals, each provided with a rheostat, two-line switches, and an ammeter, while, of the Thomson-Houston type, the six smaller ones are connected with automatic safety switches and rheostats.

A one h. p. motor mounted on a truck and operating a portable drill through the medium of a flexible shaft is also shown, and in a prominent position at this end of the space is a pivoted electric derrick of eight tons capacity with a one ton magnetic hoist for moving iron castings, etc., without the use of hooks or chains. The motor employed is a six h. p. machine of the Thomson-Houston type employing a train of four reducing gears to the drum. Near this is a factory truck or flat car with two 7½ h. p. waterproof motors. A Sturtevant blower directly coupled with a 1½



THE GENERAL ELECTRIC COMPANY'S RAILWAY AND MOTOR EXHIBIT AT THE WORLD'S FAIR.

on the Thomson-Houston roads until the introduction of the waterproof type, stands near-by, and to the left and right in the centre of the curved track, extending across the front of the exhibit, is a large Stephenson truck with two single reduction "F. 30" 15 h. p. motors. A Bemis truck with two "G. E. 800" 15 h. p. motors occupies the left end of the track. Just back of these stands a Robinson radial truck with two 25 h. p. waterproof motors and an electric headlight, and near this a Jackson & Sharp truck with two 125 h. p. motors of the type used on the Intramural railway, and a New York air brake with a General Electric air compressor.

On the large board in the centre will be seen a diagram showing the wiring connections and general arrangement of apparatus on street railway cars. At either end of the board are shown overhead construction details and at the back is a panel switchboard with automatic circuit breakers for 300, 500 and 800 amperes, and the usual current indicators, rheostats, meters, switches, etc.

Back of this stand three multipolar generators of the h. p. motor stands near by, and the exhibit closes with three small motor generators mounted upon a platform at the southern end of the space, the largest of 85 and 120 watts, and the other two 85 and 120 watts each.

The exhibit was arranged by and is under the charge of Mr. W. D. Young.

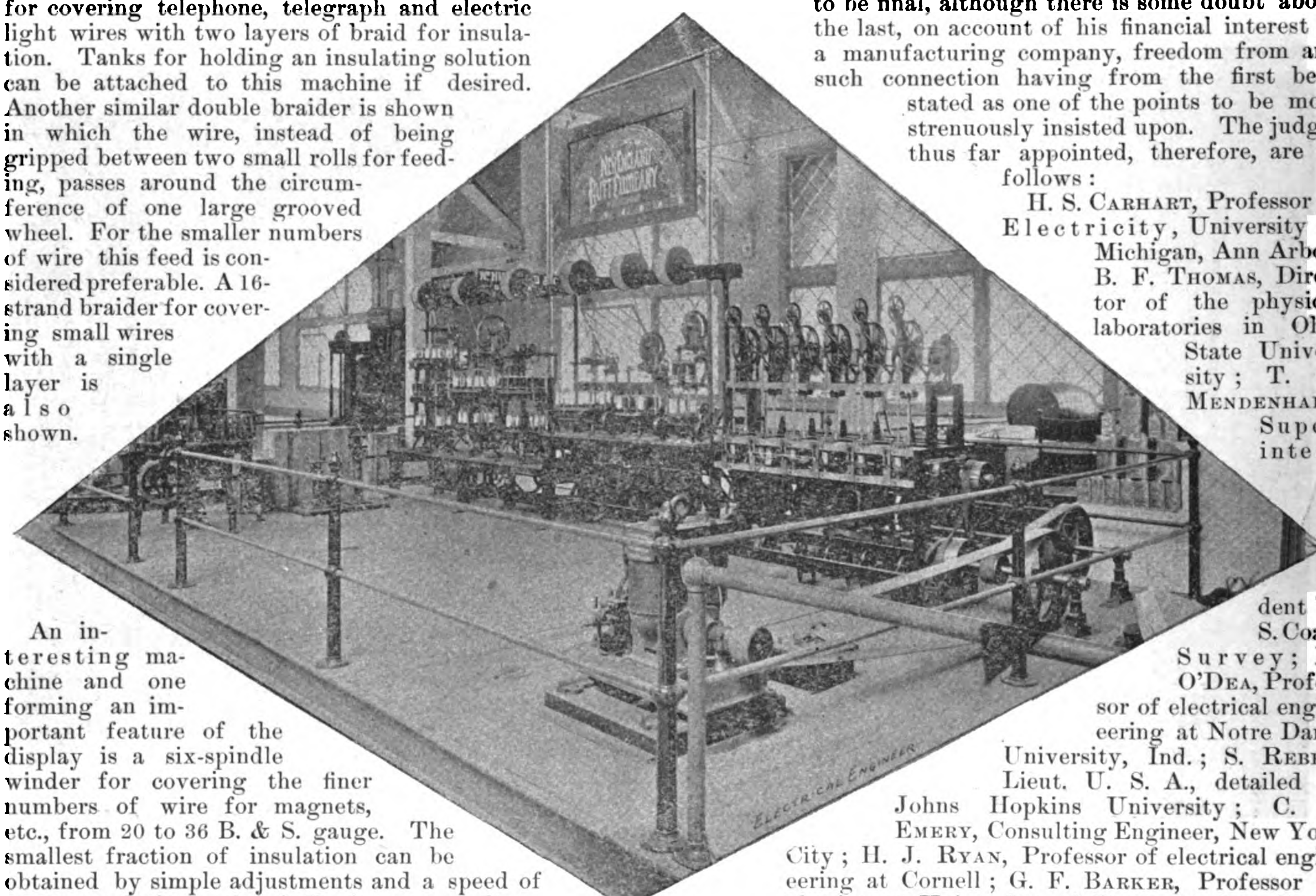
LOW FREQUENCY MOTORS AT THE FAIR.

The fact that the Westinghouse Company are using very large generators of an unusually low frequency in the World's Fair lighting has proven a stumbling block to the manufacturers of alternating current fan motors in placing their motors on the World's Fair circuits. The Electric Appliance Company with their usual enterprise have come to the front with a Meston fan motor, wound particularly for the World's Fair work, and have succeeded in securing results that have been a surprise to themselves as they find that their World's Fair motor is even more efficient than the regular motor which has always been celebrated as an exceedingly efficient alternating machine. They are also making arrangements to have the motors rewound after the World's Fair at a nominal expense to operate on alternating circuits of ordinary frequency where customers so desire.

THE NEW ENGLAND BUTT CO. AT THE FAIR.

The New England Butt Co., with whose apparatus the readers of The Electrical Engineer are already familiar through the accounts published in these columns, and by use of it, have an excellent display of braiders and wire covering machines in the east gallery of Electricity Building, operated by the Knapp Electrical Works of 54 and 56 Franklin street, Chicago.

A General Electric motor of three kilowatts drives a countershaft to which the braiders are belted so that all may be shown in operation. This is one of the very few "live" exhibits in the building. The machines taking power from this countershaft represent the most important of the company's make, especially for electrical purposes. A 16, 20 and 24 strand improved triple braider with a 14-inch wheel take-up for covering telephone and other small electric wires heads the list. Next there is a double braider with scored feed rolls, especially designed for covering telephone, telegraph and electric light wires with two layers of braid for insulation. Tanks for holding an insulating solution can be attached to this machine if desired. Another similar double braider is shown in which the wire, instead of being gripped between two small rolls for feeding, passes around the circumference of one large grooved wheel. For the smaller numbers of wire this feed is considered preferable. A 16-strand braider for covering small wires with a single layer is also shown.



An interesting machine and one forming an important feature of the display is a six-spindle winder for covering the finer numbers of wire for magnets, etc., from 20 to 36 B. & S. gauge. The smallest fraction of insulation can be obtained by simple adjustments and a speed of 3,000 revolutions of spindle insures a large output. Empty bobbins are replaced by full ones without cutting the wire; there is an automatic stop motion for each head and a simple device for turning back the wire for mending should occasion require. The traverse arrangements for reels are well built and durable and the whole machine in fact is eminently adapted to the work it is intended to perform. Here is also a double winder for covering office and annunciator wires with two layers of cotton or silk. The capacity of this machine is from four to six feet a minute according to the size of the insulating thread.

In addition to the apparatus shown, the company manufacture at their factory at Providence, R. I., a great variety of devices for similar purposes, including twining machines for lamps cords and telephone pairs, polishing and tapering machinery for wires, the latter for rubber, paper or cloth from ¼ to 1½ inch in width, placing two layers at once in opposite directions, cabling and cable covering machines, circular looms, stranding machines and measuring machines for wires up to ten thousand feet in length. The exhibit, though not large, is well selected and gives a good idea of the extreme nicety with which this class of work may be accomplished.

THE JURY OF AWARDS IN THE ELECTRICAL CLASSES.

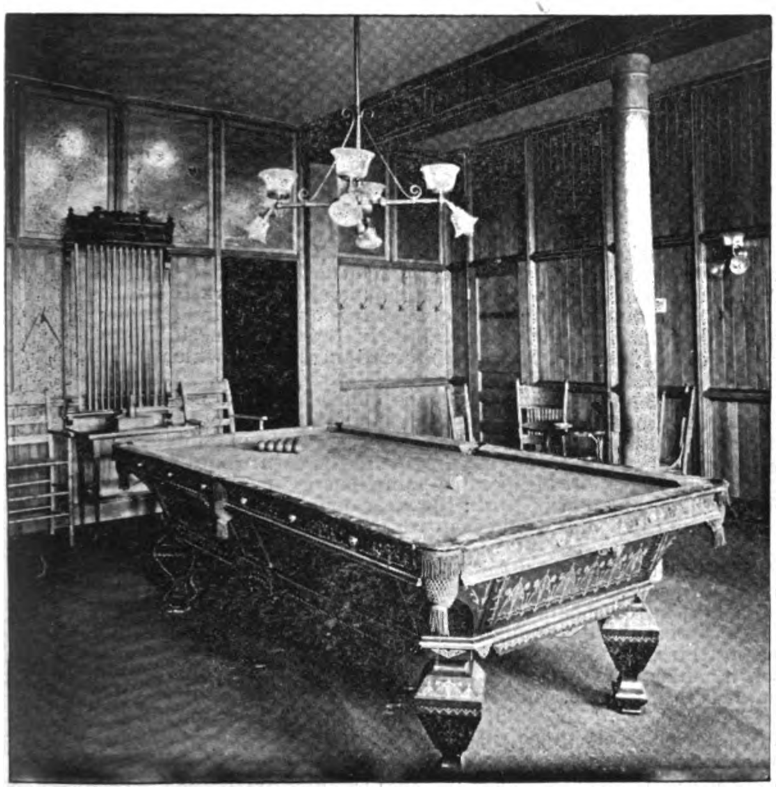
During the last two or three months the selection of men competent to judge of the merits of the various exhibits at the Fair has created an undercurrent of excitement while the more important matter of getting the exhibits ready to be looked at has been going on. In the Department of Electricity columns of names have been submitted, objected to on various grounds, revised and resubmitted until from the latest list of twenty-five twelve gentlemen have been selected by the Awards Committee and nominated as the American judges. This selection is said to be final, although there is some doubt about the last, on account of his financial interest in a manufacturing company, freedom from any such connection having from the first been stated as one of the points to be most strenuously insisted upon. The judges thus far appointed, therefore, are as follows: H. S. Carhart, Professor of Electricity, University of Michigan, Ann Arbor; B. F. Thomas, Director of the physical laboratories in Ohio State University; T. C. Mendenhall, Superintendent U. S. Coast Survey; M. O'Dea, Professor of electrical engineering at Notre Dame University, Ind.; S. Reber, Lieut. U. S. A., detailed to Johns Hopkins University; C. E. Emery, Consulting Engineer, New York City; H. J. Ryan, Professor of electrical engineering at Cornell; G. F. Barker, Professor of physics at University of Pennsylvania; R. B. Owens, Professor of electrical engineering at University of Nebraska, Lincoln; W. M. Stine, Professor of electrical engineering, Armour Institute, Chicago, Ill.; H. A. Rowland, Director of physical laboratories, Johns Hopkins University; E. P. Warner, Chief electrician of the Western Electric Company, Chicago.

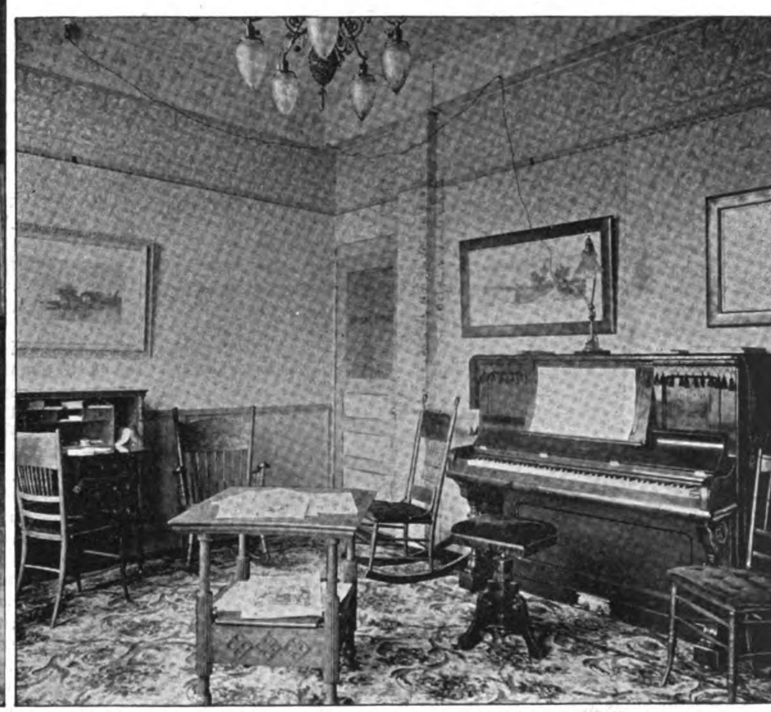
The English judges appointed are Prof. Ayrton and Prof. George Forbes, both of whom have gone to Chicago to take part in the first meeting of the jury on Monday July 16. Germany has appointed as her jurors, Director Rathman and Baurath Ulbrecht, and Belgium has named Mr. Pierre Dehousse. France is still out although it is thought she may fall into line by and by, and Russia, Austria and Sweden, each of whom is to have one or more judges in this department, are yet to be heard from.

It is quite possible that these lists may be added to before the entire jury is complete. Desirable additions will, of course, readily suggest themselves, without any reflection on the choices already made by the authorities.

THE ANSONIA ELECTRIC CO.'S WORLD'S FAIR CLUB ROOMS.

NOTHING more thoughtful or kindly in connection with the arrangements for electrical visitors to the World's Fair has been done than in the opening of a clubhouse by the Ansonia Electric Co. at its business headquarters corner of Randolph street and Michigan avenue. Mr. F. S. Terry has done many "clever" things, but this act illustrates all the meanings of that expressive adjective. Through his thoughtfulness any electrical man going to Chicago alone or with his family now has all the comforts and privileges of a first-class club where he can obtain everything except food and a bed. This suite of club rooms occupies one of the floors of the Ansonia building and is under the direction of Mr. G. B. Shaw, of Eau Claire, Member of Congress elect, and at one time general manager of the National Electric Manufacturing Co. We give here views of two of the club rooms, which are as bright and cheerful as they can possibly be. They are not only handsomely furnished but provided with telegraph, telephone and messenger service, stationery, check room for baggage, lockers for valuables, newspapers and magazines, piano, billiard table, lavatories, etc. There is a fine view of the Chicago waterfront, and every point of interest in the city is in close range for business purposes or for inspection. Mr. Terry has issued membership cards for the club, and wishes it well understood that every "clubbable" man in the electrical field will find himself in "good standing" at the Ansonia when he goes to Chicago during the World's Fair year.





ANSONIA ELECTRIC CO.'S WORLD'S FAIR CLUB ROOMS.

EXPLANATION OF THE KENNEDY TRANSFORMER EXPERIMENT.

IN a recent issue we described an interesting experiment devised by Mr. Rankine Kennedy to show the effect of approaching and separating the iron plates of a transformer. In this experiment an apparently anomalous result was obtained, a lamp in the secondary circuit brightening when the plates were separated and dimming when the plates were forced together. In explanation of this result Mr. W. S. Boult writes as follows in the London *Electrical Review*:

When the U-shaped plates are massed together, the average length through air of the lines of force thrown out from all parts of the coil, and passing through the iron plates, is much greater than when the plates are evenly disposed along the coil. Naturally, therefore, the part of the primary coil covered by the plates, not being nearly sufficient to cause magnetic saturation of the iron, the total induction is greater in the latter case than in the former. If this is the true explanation Mr. Kennedy is at fault in assuming that "by this experiment it is found that parting the iron inside of the coils" (of a transformer) "also increases the induction through them."

Mr. Wm. Mordey suggests the following explanation:

When the plates are apart the surface of iron exposed to the air (the polar surface) is large, and the cross-section of the air-gap is greatest. When the plates are pressed together the polar surface is decreased, and with a given magnetizing force the magnetization is reduced, the lamp in the secondary being dimmed. If the lamp were placed in the primary instead of the secondary, it would increase in brightness instead of decreasing. The iron, if free to move, tends to place itself so that the magnetization is a maximum. The effect would not occur with the plates of a closed magnet transformer.

LETTERS TO THE EDITOR.

LOSSES BY ELECTRICAL FIRES.

IN reading over the last issue of your paper, I notice an exhaustive article written by Mr. G. S. Boudinot, with statistics on fires from electrical currents in 60 cities. Such a crude statement in your reliable columns very much surprises me.

The statistics, as stated therein by Mr. Boudinot, are very much underrated, which I will illustrate to you.

In the Albany switchboard fire, there was a loss of over $94,000; also the Buffalo Central Station fire resulted in a loss of over $60,000. On investigation, you will also learn that the Western Union Telegraph Company, in New York, suffered a loss of over a million and a half dollars.

The three losses as stated above make a total of $1,655,000, or six times the amount compiled in the statement printed in your last issue.

Furthermore, the loss of the Temple Theatre, in Philadelphia, as admitted by Inspector Mr. McDevitt, as having been caused by incandescent wires, the loss was over $150,000.

Mr. Boudinot's statement has only $2,617 credited to Philadelphia. We notice that he has entirely ignored the burning of the Cleveland Opera House last fall, a loss of $275,000. I could cite numerous other cases.

I have given a great deal of time personally to insurance losses and causes of fire. I shall be pleased to have you call attention to the above.

C. W. KNIGHT.

WORCESTER, MASS., July 6, 1893.

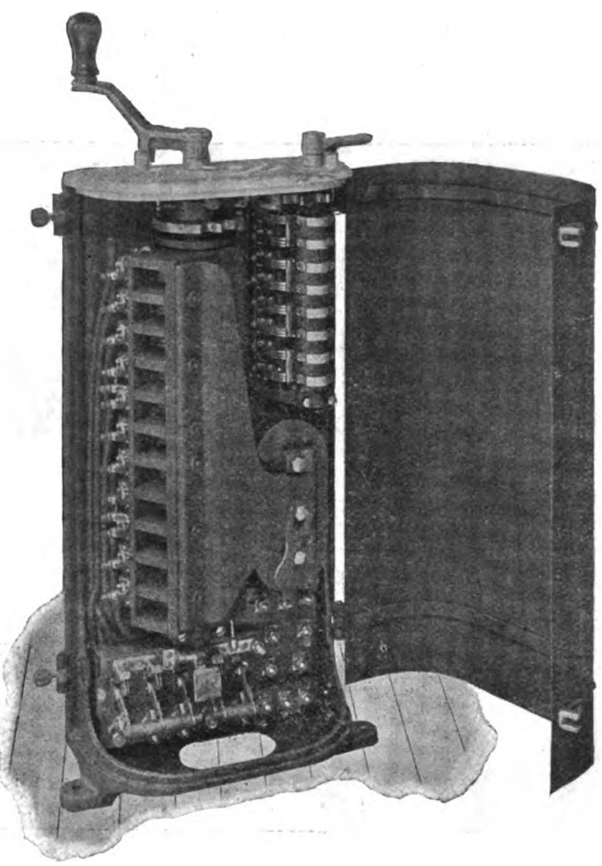
(We think that Mr. Boudinot's figures, covering one year and not all time, are quite correct. They are at any rate supported by fire department statistics, though possibly not by wild rumors and sensational newspaper yarns. We wonder that Mr. Knight while he was about it did not include a few more mysterious fires as indubitably due to electricity. However, Mr. Boudinot will probably answer for himself.—EDS. E. E.)

ELECTRIC RAILWAY DEPARTMENT.

NEW GENERAL ELECTRIC CAR CONTROLLER.

Guided by the experience gained from the progressive manufacture and close study of the operation of car controlling switches, the General Electric Company have perfected a new form of controller known as Type K, in which are combined all the good points of its predecessors, while avoiding any defects which their operation may have manifested.

This new device, illustrated in the accompanying engraving, comprises in itself all the necessary controlling movements. As will be seen, the case contains the regulating device, the connection board, motor cut-out switches and reversing switches. Rods and bell cranks are entirely eliminated and the necessity for moving parts beneath the floor of the car is done away with. Each



New General Electric Car Controller.

set of contacts is strongly insulated, and the tendency to arc on making circuit is prevented by means of the magnetic blow-out which deflects the arc sidewise from the segments and spring contacts and extinguishes it.

The general design of the reversing switch is similar to that of the controller, the segments being carried by a small cylinder, and making contact with spring fingers. Movement of the reversing switch handle through 60 deg. changes the combination of the armature leads of both motors and reverses the motion of the car. The motor cut-out switches attached to the connection board of the controller, permit of rapid and absolute disconnection of the motor from the circuit. The value of such an arrangement in case of disablement of motor on the road, will be readily appreciated by practical railroad men.

The controller is extremely simple in its mechanical construction and is easily accessible; by loosening two thumb nuts in the outer case, it may be opened and the removal of a bolt in the pole piece allows it to be swung back, giving access immediately to the interior parts. All the excellent features of controller "E" which was described at the time of the Cleveland Street Railway Convention, have been retained. The sequence of connections and speeds has been preserved; but placing the field on the ground side of the armature has necessitated a modification of the interior connections, admitting, without change, of either the shunt or loop method of control.

Every precaution seems to have been taken to secure easy and perfect operation. Proper make and break of contacts are ensured by means of a star wheel attached to the upper part of the cylinder shaft. This wheel is actuated by a spring, and throws the pointer on the handle positively to the notch on the dial, indicating to the motor man the running positions of the motor.

By means of an interlocking device between the reversing switch and controller, the operation of either, unless it is in proper position relative to the other, is impossible. The reversing switch cannot be moved over unless the controller is in the "off" position, nor can the controller be operated while the switch is between its forward and reverse position. A similarly ingenious device ensures proper adjustment of the motor cut-outs; thus, should one motor be cut out, the combinations suitable for the other can alone be made. The controller has been carefully tested under conditions of actual service and by its satisfactory operation demonstrates how great an advance has been made in the design and construction of car controlling apparatus during the last few months.

SOME SUGGESTIONS ON ELECTRIC CAR HOUSE CONSTRUCTION.

BY

L. Gutmann.

Noticing the article on Car House Construction in The Electrical Engineer of July 5, and the remedies suggested by Mr. Alfred E. Braddell, permit me to make some remarks on that subject. At first sight the idea of a grade is beautiful and simple; however, it has its drawbacks, and as Mr. Braddell himself states at the end of his note, there are circumstances under which even the grade would be of no advantage.

Such a construction in order to be efficient should not entail increased running expense on a company as a grade would do. A fire may occur once in a year or in five years and to facilitate the safe removal of cars by having a grade in the barn would require the use every day of considerable more energy from the power house than is used at present; the wear on controllers, switches, brakes and car bodies would increase to a figure which few could appreciate.

Imagine a barn almost full of cars; there is very seldom any room to spare, and one motorman after the other may have to start his controller half a dozen times to get his car in the proper place, so that there is enough room left for another car to come behind him, or to be able to pass a switch, etc. If late at night when one man follows the other with his car, everybody being anxious to go home, the cars are run in, and, on a grade would strike the forward car, and if not brought close enough would have to be started on the grade with the brake partially set, as otherwise the car would run backward into the one following. Imagine the wear on controller stands, brushes, commutators, brake-shoes and car bodies, to say nothing of coal, a daily wear and expense to prevent danger which may not arise in years.

Where then are we to strike the happy medium? The writer is inclined to answer, By using the level and no grade, in combination with a proper structure; because a very slight grade fails to perform the function contemplated, and the grade that would be effectual is objectionable from the increased expense caused by it. To construct buildings for fire protection, it will be necessary to go back to the origin of fires.

1. The building may catch fire or be set on fire. In this case the same precautions could be applied as in factories, viz., hose and proper water connections, and, if necessary, automatic sprinklers, the latter, however, in such positions that the trolley wire or poles could not come in contact therewith; if at all desirable, they may be placed one or two feet above the car body; allowance should be made so as to be able to raise the car body from the truck.

2. Fires originate from stoves in cars or from leaving a trolley pole on the line and by way of a lightning arrester with adjustable discharge blocks, loosened by constant jarring and the two terminals being bridged by carbon or copper dust. The device becomes overheated and whether it be located under the seats or not, the connecting wires located under the seats may be heated to such an extent that they will set on fire the cotton waste, rubber coats and boots and other paraphernalia of motormen and conductors found with very few exceptions in all the cars running. The lightning arrester (so-called) is not the only device that can be, but seldom is, the cause of fire; leakage of any kind, or electric heaters in combination with cotton waste and wearing apparel carelessly thrown over these wires connecting cut-out and

motors with the car controller, making of all of them efficient fire traps.

If I may be permitted to make a suggestion on the construction and location of the building itself, I would say that while the power house may frequently have to be in the centre of a city in spite of expensive location, there is absolutely no reason why the barns cannot be at one or both ends of the line at places where land is cheap. These barns could be provided with sufficient ground in the back with tracks laid down so that at least half of the car capacity could be located there temporarily. If possible the barns should not stand close to the street, but should stand back two or three car lengths so that there is some straight track for the cars to come out on and not a curve to begin with, as in most barns located in cities; because a single car standing or stalled on such a curve in passing a switch to the main track, not only blocks everything behind it, but also all cars which may be running or which it may be desired to put into operation. What good is an inclined floor in a barn with four or more tracks full of cars and but one transfer table or turntable in front of the barn, and one or even two tracks leading from it? What is the good of it in a barn where switches are required to take the cars from the track leading from the street to the sidings in the barn?

A barn should be provided with double sliding doors for back and front and the trolley wire should have a small break of one to two inches and a switch outside the building, or else a one-and-a-half to two-foot break switch for temporary disconnection of the trolley line inside the barn from that of the street and power house. With such provisions, part of the cars could be located in the back of the barn, others pulled out in the front, while there will be sufficient time left to switch the cars in front on to the main track. After having moved cars and trailers the trolley wire switch in front of the building may be opened, the barn disconnected from the power house and water applied without danger to life.

It may appear that with such well arranged quarters, a graded floor may be excellent. A slight grade may be permissible, being a *down* grade from the centre of the barn to the back doors. The grade should preferably be such that the car would have to be started before it would set itself in motion on the track so that no brakes need be used. With such an arrangement a single block or wedge would suffice, if applied to the first car of each track, to hold the rest, while the front half of the floor may be provided with a similar small grade towards the front door, or be level. However, the writer believes that inasmuch as cars will keep on running when set in motion on a level track, the above-named objections hold good also in this case, and that the level track is to be preferred. The objections to a grade of several per cent. can only be appreciated by the company that has to pay the repair bills, the men who handle the cars and perhaps those who accidentally have run a moving car against the dead resistance of a car with brakes set.

THE SCHEFBAUER OVERHEAD TROLLEY FITTINGS.

THE experience gained in the operation of electric railways has shown that much of the success of the service depends on the integrity of the overhead appliances which support the trolley wire primarily, and which act as safeguards in case of any breakage or other interruption.

Mr. R. Schefbauer, of 188 River street, Paterson, N. J., whose work in the department of arc lamps is already known to our readers, has recently devoted considerable attention to the working out of a series of safety overhead trolley wire fittings, with the result that he is now ready to place upon the market a number of interesting and highly practical devices. Among them we note an automatic circuit breaker intended to be placed at every section of 100 or 120 feet. It consists of two similar lever arms pivoted on an insulating block and so constructed that in the normal position one side of each of the lever arms makes contact between the pair of clips attached to the feed wire. Should a trolley wire break, it pulls down the arm of the lever, pulling out the lever between the clips and thus breaking the circuit. There being two such arms to each circuit breaker, the arrangement operates to work in both directions. This circuit breaker is specially adapted for large railroads having heavy traffic; as it cuts out only one section of 100 to 120 feet, it leaves the rest of the line operative.

The Schefbauer automatic straight line circuit breaker is intended to be placed at distances of 1,500 feet and operates so as to break the circuit in two places. It is constructed in such a manner that the shifting of the trolley wire, due to a break, opens the circuit and cuts out the current for a distance of 1,000 feet.

The Schefbauer insulated cross-over consists of two pairs of arms placed at right angles to and insulated from each other. At the end of each arm is a clip into which fit the knife blades attached to the arms into which the trolley wires run. These arms are pivoted and are held in their normal position by the wire; the knife blades make contact with the clip above. Any break in the trolley wire throws the pivoted arm down and opens the circuit. The cross-over is so designed that the arms can be ranged to any desired angle of crossing. It is very easily adjusted and maintains perfect insulation between the two trolley wires. Another device is a section insulator of most substantial construction.

All these fittings are got up in the most workmanlike manner, and have been in use for some time on the Paterson, N. J., electric railway with eminently successful results. Large shops are now in course of construction at Paterson, N. J., for carrying on the manufacture of the Schefbauer specialties.

ALUMINUM TICKETS ON THE KALAMAZOO, MICH., CITIZENS' ELECTRIC STREET RAILWAY.

MR. G. K. WHEELER, the general manager of the Citizens' Street Railway Co., of Kalamazoo, Mich., sends us two aluminum tickets now used on that road. They are very pretty, light and bright tokens, about the size of a silver quarter-dollar; one round, for ordinary fare; the other, octagonal, for children. The superscription states the purpose of each, and is supplemented by Mr. Wheeler's neat autograph in miniature fac-simile. Mr. Wheeler writes us:

After a long experience and study of the ticket question we had come to the conclusion that a metal ticket was the most desirable ticket which could be used on street railway systems, and therefore we decided upon the use of aluminum for the reason that it is a light metal and holds its lustre.

The adult's ticket we sell at the rate of six for a quarter and the child's ticket at the rate of 10 for a quarter. We do not permit our employees, either conductors or motormen, to sell these tickets to the public; they are sold by the railway company in $10 lots to the several storekeepers, who handle them exclusively. This method of disposing of the tickets prevents to a certain extend the difficulties which railway companies have had with their employees when permitted to sell tickets in connection with receiving cash fares. The use of the aluminum ticket has another advantage in that it requires no cancellation, and as soon as the tickets are turned in by the public to the railway company they are immediately done up in packages and disposed of again.

This style of ticket has met with much favor in Kalamazoo, and is handled by a great many store-keepers, and even some of the banks as cash. The adult's ticket is not objectionable even though it is the size of a quarter, the same being easily distinguished on account of the difference in shade of the metal and also by its lightness.

These are the first aluminum tickets which have been used in this country.

"ONE OF THE GOOD POINTS OF ELECTRIC CARS."

MR. J. WILSON BROWN, of Brimfield, Mass., sends us the following item, under the above caption from the Springfield, Mass., *Union:*

There's one especially fine thing about Springfield's electric cars—they can let go of the wire, and that's more than can be said of New York's cable cars. A gripman tried to stop on lower Broadway, Wednesday afternoon and found the grip was of the bulldog sort, unwilling to yield. On whirled the car down the crowded street, collecting carriages for souvenirs and creating general havoc and consternation. That no one was killed is a mystery, for six streets were traversed in this wildcat race, and but for a bystander's presence of mind the car would be going yet. A telephone message to the power station stopped the cable, and then it was found that the accident was caused by so slight a thing as a broken strand. Now it stands to reason that cables, made of innumerable strands, must be subject, in the long run, to breaks of this character, and it is difficult to see how serious disasters can be averted, if the system is retained. At any rate the electric trolley suits Springfield. Accidents have been caused by our own cars, it is true, but in most of the cases there has been carelessness on the part of the victims. When the safeguards now being tested are in successful operation, the city will have a street car system second to none.

REGULATING THE TROLLEY IN BROOKLYN.

GEORGE W. PLYMPTON and F. R. LEE, Commissioners of Electrical Subways in Brooklyn, invited the presidents of all the railroad companies that use electric motive power to a conference held on Monday last. The Commissioners say that the most obvious sources of danger to pedestrians from trolley cars are, first, too great velocity; second, unskilled motor drivers, or drivers whose vigilance is handicapped by the encroachment of passengers upon the platform, and third, insufficient guards or fenders before and about the wheels. They recommend two attachments to each trolley car.

First—A sliding platform, projecting some two feet in front of the dashboard, designed to catch the individual who has been tripped by it.

Second—A fender that is dropped in front of the wheel, clear to the track, by the operation of applying the brake.

The latter device will push along on the track anything which the platform may have passed over.

PATENT NOTES.

THE PATENT OFFICE PROSTITUTED TO POLITICS.

THE whole domain of applied electricity is at present reduced to a frightful state of delay, uncertainty and insecurity by the delay of the issuance of new patents and in the non-appearance of the *Patent Office Gazette*, which has not been seen for two weeks. The following from Washington in the New York *Evening Post*, under date of July 12, explains the trouble:

The situation in the Patent Office is growing steadily worse instead of better. Applicants for copies of patents which ought to have been ready on the 4th of July are still unable to get them, and the *Patent Office Gazette* of that date is still unpublished. Meanwhile the patent attorneys are making the air blue with their complaints. One of them, who did succeed finally in getting a patent of the issue of July 4 put through the mill, declares that he will not accept it; his client is a foreign inventor, and he is ashamed to send him such work. It is understood that he intends to demand of the Commissioner of Patents that these plates be one over again.

Meanwhile another patent-issue day has passed, but it brought only a meagre fraction of the 450 patents prepared for issue, while the *Gazette* for the week is still unheard of, and probably not even touched. At this rate there is no telling where the office will be landed after a few more weeks. When it is remembered that the preparations for last week's issue were begun in the middle of June, and that neither all the patents nor any of the *Gazettes* are at hand yet, it will be seen that the evil is certain to be cumulative and to lead to inestimable confusion and annoyance.

One of the most unpleasant features of the business is the attempt apparently made by the authorities in the Patent Office to conceal from the public the predicament into which they have got themselves. Every subordinate about the Office maintains a silence which wears the look, at least, of being compulsory, while from the heads of the establishment all that can be wrested are a few pretences of hopefulness which deceive nobody. The plain English of the situation is that the Commissioner has been treating like a toy a huge enterprise whose importance, in his inexperience, he does not understand. There are rumors afloat which give the case even a less agreeable look than mere "playing at politics," though these do not reach into the Patent Office. So far as the Commissioner is personally concerned the worst that can be said of him probably is that he is anxious to oblige a Democratic friend and does not realize that his friend is making a tool of him.

MAGNETIC QUALITIES OF IRON.

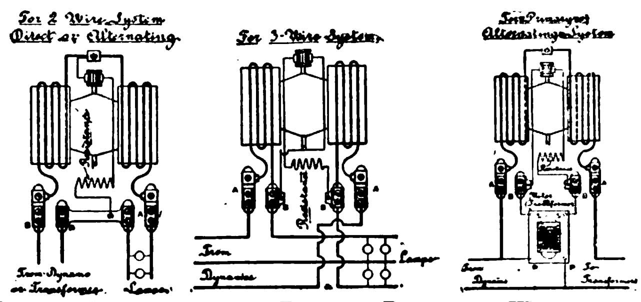
A PAPER by Prof. J. A. Ewing, and Miss Helen G. Klaassen Lecturer in Physics, Newnham College, has been communicated to the Royal Society. The paper describes a series of observations of magnetic quality in various specimens of sheet iron and iron wire. A principal object was to determine the amount of energy lost in consequence of magnetic hysteresis when the iron under examination was carried through cyclic magnetizing processes between assigned limits of the magnetic induction B. Many cycles were gone through in the case of each of the specimens, the limits between which B was reversed being varied step by step in successive cycles, to allow the relation of the energy expended or of $\int H\,dI$ to B to be determined. The iron examined was, for the most part, thin sheet metal or wire such as is used in the construction of transformer cores. The experiments show that there are marked differences in the values of $\int H\,dI$ in different specimens, some nominally soft iron requiring two and even three times as much work to be spent in reversing its magnetism as is required in the best iron. They show, further, that great permeability does not necessarily imply small hysteresis losses. It is shown that although the formula proposed by Mr. C. P. Steinmetz ($\int H\,dI = c\,B^{1.6}$) may serve fairly well as an approximate statement of the relation within those limits of B which are important in practice, it fails when applied to the more extreme portions of the curve. The authors go on to describe a second group of experiments, in which direct measurements were made of the heat developed in magnetic reversals, the method consisting in using two rings, alike in all respects, with divided magnetizing coils. The authors could not detect any difference in the amount of energy consumed in the core when the "load" was taken off or put on the secondary. In a third group of experiments the magnetic curve tracer was used. The time-lag in magnetization is well shown by the curve-tracer, and the effects are compared of the same cycle of magnetic force gone through at various speeds. It is shown that in solid bars 1.9 cm. in diameter, especially in soft iron, remarkable evidences of time-lag are seen, even when the period of magnetic reversal is as long as three seconds. The work spent per cycle is a maximum at a particular frequency, which in such bars is very low.

THE CIRCUITS AND OPERATION OF THE THOMSON RECORDING WATTMETER.

IN reply to a query appearing in our issue of May 8, p. 439, it was stated that the fields of the Thomson wattmeter were in shunt to the armature, the idea which we desired to convey being that they were *not in series*. A valued correspondent points out, however, that our brief description might prove misleading, and has kindly furnished us with diagrams of the circuit arrangements of the Thomson wattmeter as connected to the two-wire, three-wire and alternating systems of distribution. In the actual instrument the field takes the full current to the lamps and the armature, in series with a non-inductive resistance, is connected across the mains, as shown in the accompanying diagrams. The resistance in series with the armature is from 10,000 to 20,000 ohms in some types of meters.

In answer to another query in the same issue it was stated that a motor will slow down in proportion to the increase in the number of lines of magnetic force produced in the field by the increase of current in the field circuit.

Our critical correspondent, however, draws our attention to the fact that the Thomson wattmeter may be considered as a motor and yet the speed increases directly with the field. This, he explains,



CIRCUIT ARRANGEMENT OF THOMSON RECORDING WATTMETER.

is due to the fact that the counter-E. M. F. (a very small fraction of a volt), is practically nil compared with the high resistance of the armature circuits. He also points out that with a series motor on a constant current circuit the speed increases with the strength of field.

There was a typographical error in our previous reply which makes our meaning somewhat doubtful and involved,—$\frac{E}{H}$ being used instead of E. The phrase should have read: "Now since L is constant and E is also, it follows that," etc. Our reasoning, nevertheless, is strictly correct, even for moderately high armature resistances, since the increase of magnetic field strength will increase the counter E. M. F. and (E being constant) will reduce the armature current. This (for given torque) will cause the speed to be reduced. But in the Thomson wattmeter the above data communicated by our correspondent, show an extraordinary case of high armature resistance whereby, as correctly stated by him, the counter-E. M. F. factor becomes almost negligible (only a small fraction of a volt) in comparison with the drop due to resistance itself of the armature circuit. In other words, we have to deal here with a motor whose efficiency is sacrificed, being made a fraction of one per cent., in order to secure other qualities, to-wit, that of having a practically constant current in the armature circuit independently of armature speed although working at constant potential.

It is needless to say that the question asked did not imply, and our explanation was not intended to cover such extreme particular cases. In the case of a series motor on an constant current circuit E, the potential at the terminals of the armature, is not constant, but may vary to any extent; hence (for given torque), when the brushes are not moved, the increase of the field strength will cause an increase of speed. In this case there are three variable factors, E, L, H, in the equation $E = H\,L\,V$; in which E is the potential at the armature terminals; H, the strength of field; L, the length of wire in the armature; and V, the speed of armature. Increasing H causes E to increase, and this reacts so as to cause V to increase, the process being repeated (if precautionary means are not taken), until E represents all the available potential difference acting on the circuit, *after which further increase* of H would cause the speed to diminish.

PERSONAL.

MR. M. B. MATTHEWS, who for 12 years has been connected with the interests of the Edison and General Electric Companies, has accepted a position with the New York Board of Fire Underwriters. Mr. Matthews' many friends will be glad to hear of his success and will wish him continued prosperity.

MR. WM. HAZLETON 3RD has resigned his position as assistant general manager of the Short Electric Railway Company.

LEGAL NOTES.

THE QUINSIGAMOND ELECTRIC POWER AND LIGHT COMPANY, WORCESTER, MASS., RULED OUT BY THE GAS AND ELECTRIC LIGHT COMMISSION.

THE Massachusetts Gas and Electric Light Commission has issued its decision revoking and annulling the franchise granted by the mayor and aldermen of Worcester more than a year ago to the Quinsigamond Electric Power and Light Company to erect poles and run wires to supply electric lights in that city. The aldermen granted this franchise against the protest of the Worcester Electric Light Company. That company took an appeal to the state commission which gave a hearing to both companies.

The Quinsigamond Electric Power and Light Company was a a project of the owners of a private plant who organized a company and proposed to turn into it their existing electric plant. Its proposed capital of $10,000 had not been paid in. The idea as announced at the hearing before the commission was to establish a plant at Lake Quinsigamond to compete with the Worcester Electric Light Company in Worcester. The capital was to be increased as need arose, and local capitalists had indicated an intention to go into the new enterprise.

The decision, signed by Commissioner Barker, is based upon broad grounds of public interests and policy. A competing company is not desirable, because it would needlessly encumber the streets with wires, it would not furnish light or power more cheaply than the present company, and there would be danger of consolidation or absorption with consequent "stock development" and an increased tax on consumers. The Worcester Electric Light Company was furnishing first-class service and doing it as cheaply, both for the municipality and private consumers, as any company in the state.

The commissioners' decision gives a full history of the case, and the reasons which have influenced them in annulling the franchise granted by the aldermen. Following are extracts from the decision :

Since the year 1883 the city has been supplied with electric lights by the Worcester Electric Light Company. This corporation has established its station within a short distance of the principal mercantile and manufacturing section, and upon the shores of a pond of about five acres in extent. Its plant, which has been recently constructed, includes compound condensing engines of about 1,600 h. p., and dynamos capable of supplying 820 high candle power arc lights and about 4,000 incandescents. It is actually supplying 675 arc lights and 4,158 incandescents, and has about 185 miles of wire and 3,200 poles in the public streets.

This appeal is made pursuant to the provisions of chapter 382 of the acts of 1887, which requires the board to hear all parties interested and that its decision shall be final.

The parties interested in an application of this character are the general public, the consumers, and those who have invested or desire to invest their money. The number of companies which can conveniently engage in this business must be necessarily limited, owing to the nature of the work and the fact that its conduct involves an extensive use of the public streets for the poles and wires.

There is a general public demand that such a use of the streets should be restricted, that the number of these wires should be kept at the minimum needed to properly supply the public needs, and that they should be multiplied only when some substantial advantage is to be acquired or the public convenience to be served thereby. For these reasons some probability should exist of either a saving of cost or an improvement of service to justify encumbering the streets with the poles and wires of another company.

At the hearings but few witnesses were introduced and but little evidence presented. Some of the witnesses expressed the opinion that the city afforded a fair field for two companies, but no facts or arguments were submitted in support of this view.

There was no claim nor pretense made by the representatives of the new company that they would be able to supply lights for any less price or of any better quality than those of the existing company, or that in any particular respect the service would be improved. It did not appear that the present company had unreasonably failed or refused to supply any lights for which request had been made. The company, indeed, expressed its willingness and demonsrtated its ability to supply both arc and incandescent lights to any extent that might be desired, wherever the nature of the business would permit and at reasonable rates. No criticism of its prices or its service was offered.

It is the duty of the board and its only purpose to secure to the people of Worcester so far as lies within its power, the best service at the lowest reasonable price. There is some reason to believe that the admission of the proposed company might seriously impede, perhaps wholly defeat this object. It must be recognised that both companies are to be promoted and to be conducted for the sake of profit, and that they will be governed by the same laws as other companies in similar business. The capital account of the existing company is low, and the amount required for a fair dividend is less than in most companies of its size and character. It is important to the consumers that this condition should be maintained, as no single item contributes more to the cost of lights than a proper charge for dividends.

The present company can add 10,000 to 20,000 lights to its present output, with a much smaller investment of new capital than could possibly be done by a new company. The history of corporations doing an electric lighting and similar business in competition in various parts of the country affords strong ground for believing that a new company, if allowed to engage in business, would not long remain by itself, as competition for a period would probably be followed, as elsewhere, by consolidation or absorption. Whether or not such union would be for the public good, the companies would see a gain thereby, and no power rests in this board or elsewhere under existing laws, which could effectually prevent some form of consolidation. If the advantages incident to the growth of population and the development of business are to be secured and retained for the benefit of consumers, every reasonable effort must be made to prevent unnecessary development of the capital chargeable upon the business. But combinations and consolidations, it is well known, afford the opportunity and usually a temptation to stock development too great to be resisted. Such needless outlay should be avoided and saved, for when it has once been incurred or the money expended in an enterprise not required to supply the public wants, so great is the expectation of gain and so persistent and unyielding are the demands of capital for dividends, the remedy is not then easily found or applied, and the better policy avoids the evil at the outset by preventing the expenditure.

If to sustain this appeal shall seem to secure to the existing company a monopoly of the business, it must be remembered that it can only retain this as long as the public interest is best served thereby, and that such monopoly is conditional and restricted.

If it unreasonably fails or neglects to supply light when requested, this board has power to compel such supply.

While the interests of shareholders, present or prospective, ought not to be overlooked, the convenience, comfort and pecuniary benefit to the community are surely of the first importance.

The decision is dated June 30, and was printed in full in the *Worcester Spy*.

THE NEW YORK BROADWAY RAILROAD ENJOINED.

JUSTICE TRUAX of the Supreme Court upon the application of the Empire City Subway Company, Limited, through its counsel, Melville Egleston, has granted a temporary injunction restraining the Broadway and Seventh Avenue Railroad Company and the Houston, West Street, and Pavonia Ferry Railroad Company from building, maintaining, or operating any subway or conduit for the reception of telegraph or telephone conductors in any part of Broadway from the Battery to Fifty-first street, and from placing any telegraph or telephone conductors in any subway along Broadway except those owned by the plaintiff company.

THE ACTION OF ELECTRICITY ON THE CARBURATION OF IRON BY CEMENTATION.

AN interesting process has been devised by M. Jules Garnier for accelerating the carburation of iron. In the ordinary cementation process, the bars of wrought iron which require to be carburized are packed in layers in a mass of powdered carbon, and are sustained at a bright red heat for a time which depends on the size of the bars, and to the extent to which they have to be impregnated with carbon. Slight case-hardening will usually occupy only a few hours, while the complete production of blister-steel bars from merchant or puddled bar will take from ten to fifteen days. During the whole time, the stack must be kept at a high temperature, at, of course, a considerable expense in fuel. Blister steel is used to some extent in the arts, while case-hardening is largely resorted to in mechanical and electrical engineering; so that any modification of the process which will reduce the consumption of fuel, or accelerate the process, will be of no small importance.

It occurred to M. Garnier, whose experiments have been communicated to the *Académie des Sciences* by M. Moisson, that it might be possible to increase the activity of the process of cementation by means of the electrolytic action of a current, using an anode of carbon and a cathode of the iron to be carburated, the electric current being passed while both cathode and anode were maintained at furnace temperature. To test this, a rod of carbon and a bar of extremely mild steel (0.1 per cent. of carbon) were placed end to end, and well insulated from one another, in a tube or barrel of some refractory material. This was then placed horizontally in a reverberatory furnace, heated by a blast of air supplied from underneath. While thus kept hot the carbon rod was connected to the positive, and the iron bar to the negative, pole of a Gramme machine capable of supplying a large current at a low pressure.

A current of 55 amperes under a pressure of 7 volts was maintained between the carbon and the iron for three hours; after which the bar of iron was quickly taken out of the furnace and instantly plunged into cold water. The end of the bar which had been opposite the carbon rod was now able to scratch glass very strongly, and when it was ground to a beveled edge at an emery wheel, it indicated that cementation had taken place to a depth of 10 mm. On repeating the experiment, but with a mild steel bar in place of the carbon rod at the anode, and a similar bar at the cathode, it was found that, while the anode was not hardened nor modified in the least, the cathode was strongly carburated by the electrolytic impregnation of carbon.

ELECTRICITY IN HYGIENE.

AN apparatus for electrically transmitting records of the temperature of a fever patient is said to have been devised by M. Tavernier, and to have been tested in Parisian hospitals. In addition to a thermometer, a "fever measurer" is placed under the armpit, and is connected electrically with a recorder in the service doctor's room. When the temperature of the patient rises one or more degrees, a record of this fact is transmitted, so that the physician can ascertain the condition of the patent at any moment without leaving the room, the recorder being provided with a number corresponding with that on the bed of the sick person.

CONVERTING A GENERATOR INTO A MOTOR.

ONE of our correspondents writes us to inquire if a Brush incandescent generator can be rewound to make a 500 volt motor. He informs us that he has talked with a number of persons who are familiar with Brush apparatus none of whom were able to give the desired information. Will some of our readers kindly give us their experience for the benefit of our correspondent?

THE CONTINUOUS CONTROL OF UNDERGROUND CONDUCTOR SYSTEMS.[1]

BY DR. M. KALLMANN.

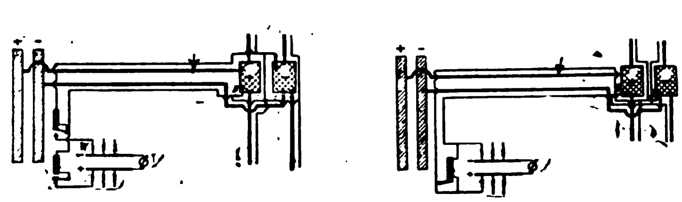
THE enormous sums spent in the cables of electric lighting stations during the past few years has made the problems of how best to preserve them from injury, and, when injured, to find the fault expeditiously, two of the most important questions of the day; and the best means for grappling with such a problem is to be quite clear on the subject of all possible causes of disturbance or injury. To examine all possible means of preserving cables is not the object of this paper, which is directed to the questions (1) of continuous insulation tests; (2) of automatic location of faults.

The author has devised a system of signaling at the station the insulation condition of the smallest possible portion of a large network, but before going into the theory of it he gives an account of some practical arrangements of a Berlin central station, which have been working during many months.

In such a large cable system as that of Berlin injuries are constantly happening to the cable, through workmen and others, and the device is intended to give an alarm at the station whenever such an accident occurs, and to show the district within which it has taken place. In order to do this, the insulated pressure wires, which are used for voltmeter wires to show the pressure at different points in the system, are made use of. The arrangement is shown (on a two-wire system for simplicity's sake) in Figs. 1 and 2. The author then enters into details of the Berlin system, which has about 400 miles of street conductors divided into 115 districts, the area supplied being about 2.5 square miles, and containing about 650 junction boxes, where, by taking out fuses, every conductor can be cut out. In Berlin each pair of pressure wires serves an area of about 70,000 square yards, and a cable length of about 1¼ mile; and it is, therefore, generally not necessary to open more than three boxes in order to find the defective cable and cut it out. The arrangement of the combination apparatus is shown in Fig. 1, the essential point being that the pressure wire in each cable is connected to the opposite main, so as to keep up a difference of potential between it and the cable in whose sheathing it is run, in Berlin amounting to 220 volts. At the station each feeder pressure wire has a relay in its circuit, of suitable sensibility, for the purpose of attracting an armature and ringing a bell if any disturbance of the potential difference between pilot wire and main takes place. By this means any breakdown in insulation is automatically signalled at the station, without disturbing the measurements of pressure which are carried on through the same wire; and the relay which has been set in action drops a number, which indicates the district in which the breakdown has taken place, where the defective section can easily be detected and cut out. The author states that practice shows that, even if the cable is only severely injured, without actually short-circuiting the pilot wire to the cable, the earth-current quickly destroys the insulation and brings the two into contact within a short space of time.

The arrangement of Fig. 2 enables one relay to be used for both pressure wires belonging to the same district It is found that the sensibility can be so arranged that any defect of insulation, even short of a short circuit, is immediately signaled.

In addition to this signaling apparatus, there is provided for the Berliner Elektricitäts-Werke a system of automatic earth-contact



FIGS. 1 AND 2.

signaling arrangements, which can be applied to any system of cables of whatever kind, and of whatever size it may be. The theory of this arrangement rests on the fact that, when an "earth" takes place, most of the energy is converted into heat in the immediate neighborhood of the "earth," and there is only a small fall of potential through the earth itself. The idea is to determine the potential at various points in the earth when the contact takes place; the position of the fault is then shown by a relay and a 10-volt voltmeter at the station.

Fig. 3, which is self-explanatory, shows the arrangements for two districts. From the points in the network most removed from one another—for example, from every feeder junction box—an insulated wire P leads to the station, and passing through a relay R, is put to earth. From the other pole, or middle wire, a conductor which can be cut out leads to earth at the station, if necessary through a resistance. Each pilot wire P is also put to earth in its own district, and the relay has, therefore, on its terminals the difference of potential between the earth at the station and at the district corresponding to it. This difference is small, even if several hundred amperes are passing to earth, as the fall of potential is so very local; and the disturbance can be measured on a low-tension voltmeter quite easily. This controlling device can be made of any desired degree of sensibility, by suitably winding the relays; and, as in Berlin it is not desirable to have it too sensitive for fear of needless alarms and so on, the relays are wound accordingly (1.8 volts for the Schiffbauerdamm district, for example). If the short circuit is very severe, many of the nearer relays may also give a signal, as the required difference of potential may be reached nearer the station. To find the position of the fault in this case, a voltmeter, G, is used, consisting of a simple telegraphic galvanoscope. This can be put between the "earth"

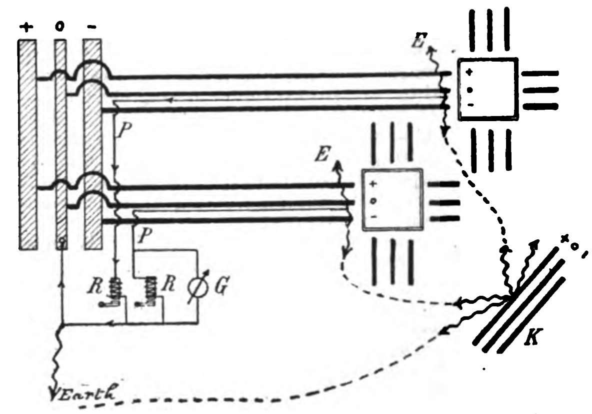


FIG. 3.

at the station and those of the various districts, by means of a switch passing over a series of blocks connected to the control wires. The galvanoscope works either with 0.5 or 5 volts at its terminals for maximum reading. The contact at which the highest potential difference occurs is that of the district in which the "earth" is to be found.

The remainder of the author's paper is taken up with the theoretical aspect of this arrangement and a description of his experiments. He concludes by calling attention to the two interdependent systems by which a complete and continual control over the whole cable network is attained, the first directed chiefly to direct injury of the street cables, while the second in general watches over all faults of insulation, signaling when they pass a certain limit, and applicable not only to underground covered cables, but also to bare conductors in culverts and to overhead wires; while it controls, in addition, all the house installations, thus making the control most complete and effective.

1. Abstract of a Paper read before the Berlin Elektrotechnischer Verein.

NEW INFLUENCE MACHINES.

AT a recent meeting of the London Physical Society, Mr. W. R. Pidgeon and Mr. J. Wimshurst each read a paper on "An Influence Machine," and exhibited their machines in action. In designing his machine, Mr. Pidgeon has endeavored (1st) to make the capacity of each sector large when being charged, and small when being discharged; (2nd) to prevent leakage from sector to sector as they enter or leave the different fields of induction; and (3rd) to increase the capacity of the machine by making the sectors large and numerous. The first object is attained by arranging fixed inductors of opposite sign to the sectors near the charging points, and of the same sign near the places of discharges. Objects 2 and 3 are secured by embedding the sectors in wax, run in channels in the ebonite discs which form the plates of the machine, and carrying wires from each sector through the ebonite, each wire terminating in a knob. In this way the sectors can be placed much nearer together than otherwise without sparking back. By setting the sectors askew with the radius, they are caused to enter the electric fields more gradually, consequently the potential difference between the adjacent sectors is kept comparatively small. Experiments showed that the use of the stationary inductors at the charging points increases the output threefold, and as compared with an ordinary Wimshurst, the output for a given area of plate passing the conductors was as 5.6 : 1. The recovery of a machine after a spark had occurred was particularly rapid.

Mr. Wimshurst's new machine consists of two glass discs, 3 feet 5 inches diameter, mounted about ¾ inch apart on the same spindle. Both plates turn in the same direction. Between the discs are fixed four vertical glass slips over 4 feet long, two on each side, and each covering about three-eighths of a disc. Each slip carries a tinfoil inductor, which has a brush, touching lightly on the inside of the adjacent disc, on its leading edge. Collecting and neutralizing brushes touch the outside of the discs, and the few metallic sectors attached thereto. An account of some experiments made to determine the efficiency of the machine was given. The author also showed that when all the circuits of the machine were broken, it still continued to excite itself freely, and sparked from the discs to the hands when brought near.

Trade Notes and Novelties

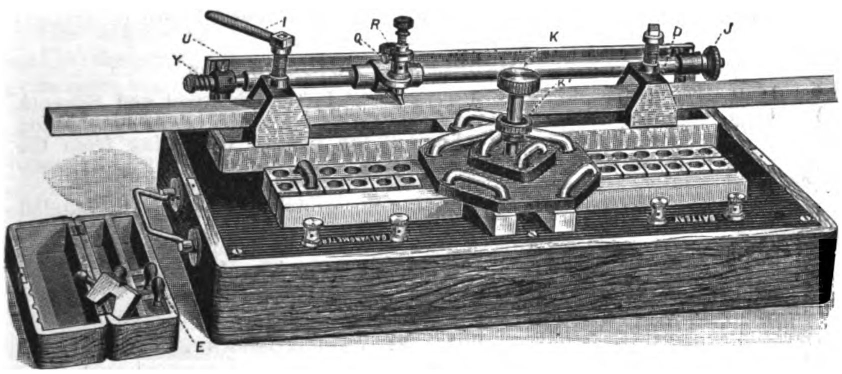
AND MECHANICAL DEPARTMENT.

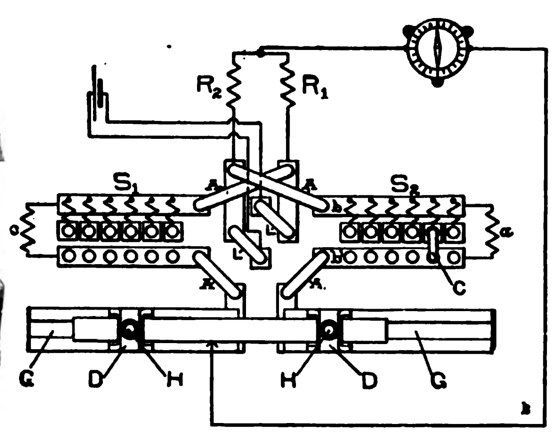
THE QUEEN CONDUCTIVITY BRIDGE.

Probably one of the most difficult and at the same time important measurements to make is that of conductivity. As usually conducted long lengths of wire or cable are required and extraordinary precautions taken as to temperature, while a number of expensive instruments, perhaps not adjusted to each other, form the testing outfit. Under these conditions accurate results are only obtainable at the hands of skillful operators.

The accompanying engravings, Figs. 1 and 2, show in perspective and in diagram a "conductivity bridge" designed by Queen & Co., Incorporated, of Philadelphia, by means of which the measurement of minute resistances is greatly simplified and freed from many of the errors to which it is commonly subject. Referring to Fig. 2, R_1 and R_2 are two approximately equal resistances (not necessarily known); S_1 and S_2 represent two groups of resistances, each group consisting of a fundamental resistance connecting together two copper bars, as b and b^1, and six accessory resistances arranged so that any one can be placed in parallel with the fundamental. One end of each accessory resistance is joined to a mercury cup between the two outside bars; a small copper connector, C, joins the mercury cup to the lower bar, as shown in the diagram. These fundamental resistances are initially adjusted very accurately, so that the two groups will differ in resistance by the decimal engraved below whatever cup the connector, C, is bridged into. A, A, A, A, are heavy copper connectors making connections between the various copper bars, as shown. These connectors are carried by a heavy rubber plate, as shown in Fig. 1.

In the front of the apparatus is a massive pair of ways, G, upon which slide massive clamps, D; each of these ways is joined to one of the groups S_1 and S_2. The connector to be tested, H, Fig. 2,





Figs 1 and 2.—Queen Conductivity Bridge.

seen as a massive square bar in Fig. 1, is slipped into the heavy clamps, D, and clamped down by means of the screw nut and wrench I. A scale, U, 50 centimetres long and divided into millimetres is supported in front of the test piece, as shown in Fig. 1. Upon a rod behind this scale moves a slider by which galvanometer contact is made upon the test piece. A fine adjustment of the slider may be obtained by means of a micrometer screw. A vernier, allows settings to be made made to $\frac{1}{10}$ millimetre.

The method of operation is very simple. The test piece being in position, connector C is placed in such a cup as will make S_1 and S_2 differ by about the resistance of the test piece. A few trials will determine this or the resistance of the test piece as given by any wire table will be close enough. Battery and galvanometer circuits being connected, as shown, the slider is moved along until no deflection of the galvanometer is produced, when the circuits are closed. The heavy connectors A, A, A, A, are now rotated through 180 degrees; this is accomplished by merely lifting the head, K, of the plate which supports them, and turning it through the above angle. The smallest plate carrying connectors L, L, will thus be rotated so as to leave L, L, in the same relative position. The effect of rotating A, A, A, A, will be to exchange S_1 and S_2, and this, obviously, will push the position of the slider contact corresponding to zero galvanometer deflection along the test piece until the amount of test piece moved over equals in resistance the difference between S_1 and S_2. All that must be done, therefore, is to take two balance readings; the length of test piece moved over equals in resistance whatever difference may have been originally established between S_1 and S_2.

All contact errors where the test piece is clamped in, are eliminated in this apparatus. For example, any contact resistance in the left hand clamp merely operates to throw *both* balance readings to the right, leaving their difference unchanged.

The entire apparatus being constructed of copper, thermal currents will not usually be of any appreciable moment. They may be eliminated, however, by reversing the battery and taking the mean of two readings as the true slider readings; that is easily accomplished by lifting head K and rotating connectors L, L, through 90 degs.

To accommodate conductors of different sizes and shapes a number of little adjusting blocks, E, are provided; these blocks fit into the clamps D, and hold the axis of the test piece, whether round, square or otherwise shaped in cross section, exactly in the axis of the clamp. With this apparatus the conductivity of copper bars up to $\frac{3}{4}$ inch in diameter and less than 12 inches long may be measured with an accuracy of $\frac{1}{50}$ of one per cent. The resistances R_1 and R_2, S_1 and S_2 are standards, permanently a part of the apparatus and guaranteed accurate to $\frac{1}{100}$ of one per cent.

This method and apparatus is the result of long-continued study and experiment in the laboratory of Queen & Co. The set is handsomely and substantially made, and when complete occupies a rectangular case 23⅜ x 11½ x 8⅜ inches deep. Wire manufacturers will see in this apparatus a means of saving much time and expense as well as of raising the standard of their goods. Manufacturers of dynamos, motors, also will find the set extremely valuable in determining whether their armature conductors are up to the proper standard of conductivity. A sample set now in the Queen exhibit at the World's Fair attracts great attention, and has been purchased for the testing department of the Armour Institute, Chicago.

A NEW CATALOGUE FROM MR. BRIXEY.

One of the prettiest of the new catalogues we have seen lately is that just issued relative to Day's "Kerite" insulated wires and cables, by Mr. W. R. Brixey, the sole manufacturer, 203 Broadway, New York City. The cover embossed in two or three shades of cool brown, is appropriately suggestive of the concern's specialties, and the whole pamphlet is well worthy of the Bartlett Press from which it issues. A brief and pithy introduction is followed by a number of tables of the various Kerite products, with sizes, weights, gauges, prices, etc. There is also a quantity of useful information of a statistical nature as to wires and cables.

THE STIRLING BOILER FOR HIGH PRESSURES.

Mr. F. A. Scheffler, the general sales agent of the Stirling boiler, 74 Cortlandt street, sends us the following:

Reports from the various agencies of this company, to the writer, together with sales which they have made recently and have in prospect, show that there is no question but that the Stirling boiler for high pressures is becoming very largely the standard. Having so many boilers in use for electrical purposes of all kinds, we are enabled to prove conclusively to the most critical customer that the boilers do more than we claim for them, and as we can show a record of never having a boiler removed for any cause whatever (except one, where we removed the boiler before it was erected, on account of the bad condition of the purchaser's finances), we have no hesitation in referring customers to present plants.

Certain adversaries have stated that our boilers in the Union Trust Company, New York City, where we have 300 h. p., are to be removed, but this is an unfounded statement, made to injure our business. We hold a letter from the Chief Engineer, stating that the boilers are perfectly satisfactory in all respects, and asking us to refute the statement point blank, that he contemplates removing the boilers.

The Fort Wayne Electric Company, has just issued a neat little circular, with colored cover. It is cut into the shape of their new "Wood" iron-clad slow speed alternator, and makes a curious and attractive brochure, well calculated to do some effective advertising.

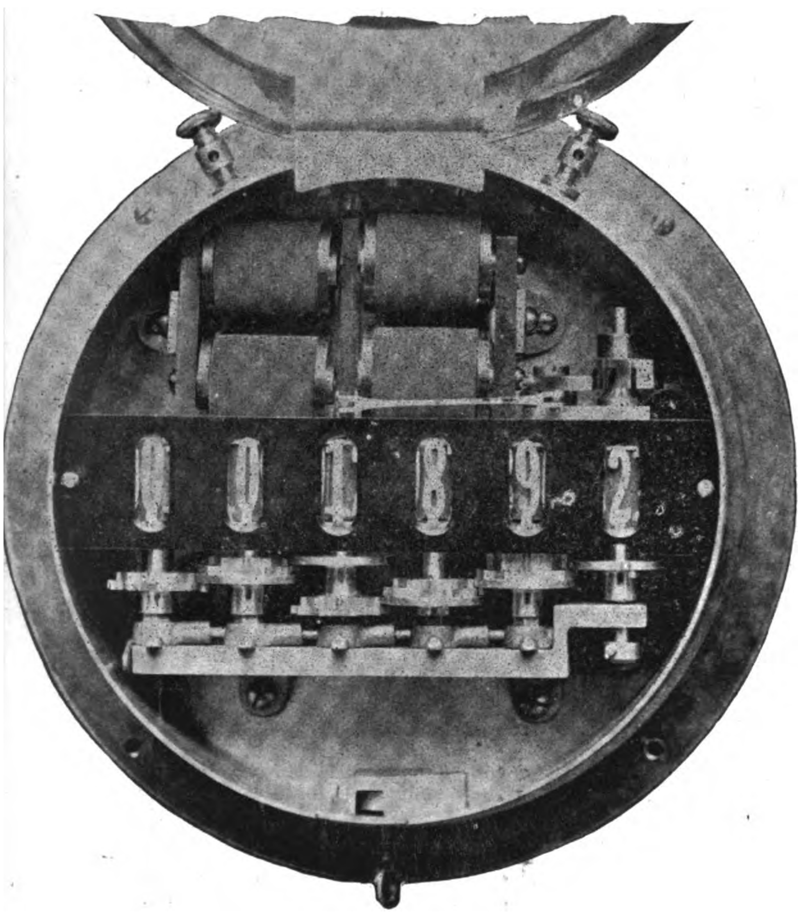
THE UTICA ELECTRIC REVOLUTION COUNTER.

So much depends upon the maintenance of regular engine or turbine speed in driving dynamos whose current is distributed to thousands of lamps and motors, that a reliable revolution counter is a necessary adjunct of every central station. The recent introduction of slow speed dynamos especially makes it desirable to secure close regulation for obvious reasons.

To meet the demand for a reliable counter, the Utica Steam Gauge Company, of Utica, N. Y., have brought out the electric revolution counter shown in the accompanying engraving.

As will be seen, the counter is operated by an armature alternately attracted by a pair of electromagnets. The engine shaft or other moving part is provided with a double point circuit breaker and the current to operate the magnets is taken directly from the circuits; in the case of 110 volt circuits a 16 c. p. lamp is placed in series with the magnets.

The figures are large (nearly an inch long), pure white, and are exhibited behind a black screen. The figures and cylinders are skeleton in form, for rapid motion, and run on steel centres, the latter fastened in a swinging yoke, for the purpose of "throwing out" cylinders to reset the counter.



UTICA ELECTRIC REVOLUTION COUNTER.

When the cylinders are all in place they are locked by a small lever. Any motion, either reciprocating or rotary, will operate the counter; the motion is absolute, and it is impossible to make a false count, even at high speed, it being locked at each stroke. On test, the counter has been operated on rotary motion, at 1,500 per minute. It is not intended to be operated at this very great speed but its ability to withstand such a test shows the perfection of its design and workmanship.

An ingenious device permits of the counter being used not only as a continuous recorder but also as a counter for any stated period, such as a minute. This is effected by the turn of a milled head which throws the counter in or out of gear. Thus with watch in hand the chief engineer, sitting in his office, can time one engine after the other, using a single counter with a multiple contact switch the contacts of which are in connection with the several engines.

Where no current is available, four cells of battery are sufficient to operate the counter.

This apparatus is also made to be operated mechanically, where the counter is placed close beside the machinery.

RIEHLE TESTING MACHINES.

THE RIEHLE BROS. TESTING MACHINE Co., Philadelphia, have just received an important order from the Civil Engineering Department of the Cornell University, for a 400,000 lb. vertical screw power testing machine with all the latest automatic and electric attachments, recording diagram apparatus, and special tools for testing girders up to 18 feet in length, transversely; also for crushing columns 10 feet high, and for applying tensile strain to rods, bars, etc., 10 feet long, stretching them, if necessary, 25 per cent. of their length before breaking. This machine is without doubt, the largest screw power testing machine in the country, if not in the world.

The Riehle Co. not long ago placed a horizontal hydraulic testing machine of the same capacity (400,000 lbs. or 200 tons) in the Boston Navy Yard. This machine weighs by means of scale levers and is, no doubt, the largest hydraulic machine with *levers* in the United States.

We are glad to note that with the development of our various manufactures, there is a growing demand for accurate testing apparatus, and the capacity is also increasing in ratio with the variety.

SPAULDING & METCALF.

AN important addition to the electrical supply facilities of Philadelphia has been made by the enlargement of their business by Spaulding & Metcalf of 55 North Seventh street. This concern has hitherto limited its trade to engineers' supplies, packing, rubber goods, etc., specially for electrical plants, but has now established a new department which will handle the products of the Campbell Electrical Supply Company, of Boston, whose "Century" insulation is so well known. A stock will be carried of all the Campbell feeder wires, cables for land and sea, line wires, shielded wire, insulating tape, paint, etc. This department will be in the hands of Mr. Chas. W. Putnam, well known as a Campbell representative, and Mr. Chas. A. Newton, who will put his energy and activity into capturing trade outdoors. The combination is a strong one, and in so good a centre of electrical trade as Philadelphia should enjoy abundant success. The general partners in the firm are F. C. Spaulding and Edward R. Metcalf.

LUNDELL FAN MOTOR OUTFITS.

THE building at the corner of Fifty-fifth street and Seventh avenue is now occupied by Tattersall, and is used as an auction market for horses. Lundell fan motors, depending from the gallery into the ring are arranged in such a manner that the spectators are unconsciously cooled into a "buying mood."

The Imperial Music Hall is completely equipped with Lundell fan motors. This is another instance of an installation in a place of amusement after a thorough trial of many fan motors, the choice always being for the Lundell. The Hotel de Logerot, the New Amsterdam, and many residences have them.

GENERAL ELECTRIC COMPANY.

IT is stated that the railway department of the General Electric Company is to be removed from Boston to New York by the end of this month, and that all the offices may be concentrated here by the end of the year. There is no very obvious reason why this economy should wait much longer.

A STRIKE ABOUT HOLES FOR THE WIRES.

THE strike of the bricklayers and electric wire men who were at work on the annex to the Mutual Life Building on Liberty street, near Nassau street, was still on last week. Forty-eight bricklayers, and eight electric-wire men have been out, both sides contending that they are entitled to the work of making holes in the walls for the wires.

NEW YORK NOTES.

THE TEEPLE ELECTRICAL CONSTRUCTION COMPANY, consisting of N. S. Teeple, N. L. Teeple and W. S. Teeple, has been organized with offices at 136 Liberty street. N. L. Teeple was formerly with the Tucker Electrical Construction Company, of this city, and latterly with the General Electric Company, while W. S. Teeple has been connected with the Sawyer-Man, Westinghouse and Edison companies. With the electrical experience thus acquired, coupled with a considerable amount of push and activity, the company feels qualified to enter the lists as an aggressive competitor with other concerns already established.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE

Electrical Engineer.

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ELECTRICAL ENGINEERING AT McGILL UNIVERSITY, MONTREAL, CAN.

THE recently completed Engineering and Physics Buildings of McGill University, at Montreal, Canada, embody in their equipment the latest and most improved machinery of Europe and America and contain much that is of interest to the electrical profession. These buildings and their equipments are the gifts of W. C. McDonald, Esq., of Montreal, whose liberality has given the University unexcelled facilities for instruction in electrical engineering and the other branches of applied science.

The course of instruction extends through four years and is designed to impart a thorough knowledge of the principles underlying the practice of electrical engineering. For the first two years the course is the same as that in mechanical engineering and covers the usual studies of that branch. As so much of the progress made in the industrial applications of electricity has been due to theoretical considerations, everything indicates that the electrical engineer of the future must be well versed in theory; special attention is therefore given to the study of mathematics and mathematical physics. For a similar reason, the instruction in experimental physics is very complete and extends through the whole four years' course. It embraces a course of lectures on sound, heat, light, magnetism and electricity. The greater portion of the time devoted to these subjects is, however, employed in practical work in the laboratories of the Physics Building, where the students, while performing experiments, acquire experience in the manipulation of delicate apparatus and learn the methods of making exact physical measurements. During the fourth year, advanced measurements and special investigations are undertaken under the direction of the professors.

The study of the industrial applications of electricity in the electrical engineering laboratories is not commenced till the third year, by which time the student is well grounded in the general principles of electricity and of the other branches of physics. The object of the lectures is not to go over ground already covered by the text books, except in cases where the subjects are not fully treated, but rather to direct the study of the students and to discuss problems arising out of laboratory work. As the aim of the course is to furnish an instruction which cannot so well be acquired afterwards in practical work, but little time is devoted to the consideration of technical details, such as, for example the repairing of dynamos and motors. These can be far better learned in some factory, where the student is recommended to go after the completion of his college course. During the third year, practical experiments in electricity and magnetism are begun, using the methods and instruments in ordinary practical use, but confining the attention to principles and not to their application. This work is preparatory to that of the fourth year, when the practical application of these principles is taken up and studied experimentally in the laboratories and dynamo room.

The following brief outline of the course shows that both the practical and theoretical sides of the subject receive careful attention. The instruction includes the theory, construction and calibration of measuring instruments; magnetism, and the design of electromagnets for special purposes; laws of induction; electrical mechanisms, such as meters, regulators and arc lamps; the theory, design and construction of dynamos and motors, embracing the efficiencies and characteristics of the different types; the various forms of armatures; alternate current machinery; the distribution and transmission of electricity, comprising the continuous current systems, the single and multiphase alternating systems, etc.; accumulators and other special applications of electricity.

THE PHYSICS BUILDING, McGILL UNIVERSITY, MONTREAL.

In addition, the student receives a practical training in the workshops during the four years' term. This is intended to give a knowledge of materials and machinery as well as skill in the use of hand and machine tools. Commencing with simple exercises, the course gradually leads up to the making of parts of structures and machines. The workshops adjoin the Engineering Building and have an area of over 25,000 square feet. They comprise a foundry containing a cupola for melting iron and a brass furnace with their appurtenances, a smith shop with forges, power-hammer, etc., and a large machine shop; also wood-turning, pattern-making and carpenter shops, all of which are fully equipped with the most improved machinery of American and Canadian manufacture.

The equipment of the laboratories in the Engineering and Physics Buildings is very complete and includes the latest and best instruments of American and European manufacture. Every contrivance for facilitating experiment is provided in the laboratories, which have been designed after a careful examination of similar laboratories

on this continent and abroad. The apparatus for the use of the students is equally as good, for the faculty consider it to be most advantageous to the student that he be trained from the very first in the use of the best and most accurate instruments.

The Engineering Building is a five-story cut-stone structure, containing the laboratories and lecture-rooms of the Faculty of Applied Science, besides a special library and reading-room. The whole of the top floor is occupied by a technical museum, containing among other apparatus a collection of Reuleaux kinematic models, pronounced by Prof. Reuleaux to be the finest and most complete collection in America.

The dynamo-room is a large, well-lighted room on the ground floor. Its equipment includes dynamos and motors of the best modern types in use on this continent and abroad, among which may be mentioned the Edison, Edison-Hopkinson, Siemens, Thomson-Houston and Victoria-Brush low tension dynamos, besides a Victoria-Brush motor-generator transforming from 100 volts to 300 volts. The arc light systems are represented by Wood, Thomson-Houston and Brush dynamos. One of Mordey's alternators supplies alternating current for experimental purposes. The armature of this machine is so contrived that besides the ordinary single-phase current, two or three-phase currents of any phase difference may be obtained from it. Besides motors of various types for experimental purposes, there are a number in use for operating elevators or furnishing power. The equipment also includes transformers, arc lamps, meters and the other appliances necessary to illustrate the commercial operation of the different systems and to familiarize the student with their peculiar features.

Two lines of shafting extend through the room; one, for constant speed, driven by a 90 h. p. McIntosh & Seymour engine and the other, for variable speed, by a 25 kilowatt Edison motor, the speed of which is controlled by varying the voltage of the dynamo which furnishes the current. Any dynamo can be connected to either shafting. One of the noteworthy features is the use of a simple and ingenious magnetic clutch by means of which the dynamos may be easily connected with, or disconnected from, the shafting. For measuring the mechanical power supplied to the dynamos or furnished by the motors, there are several forms of dynamometers, with a very perfect form of hydraulic absorption dynamometer for calibrating or checking the readings of the others. The electrical method

Engineering Building and Workshops, McGill University.

of Hopkinson for determining the efficiency of dynamos is demonstrated by two 12 kilowatt Edison dynamos, the remainder of the load being supplied by a Crocker-Wheeler motor.

The lighting station for lighting the buildings has a capacity of 1,200 incandescent lights and is illustrative of the best English and American practice. It was fully described in a recent issue of The Electrical Engineer. During light loads, current is supplied by an accumulator plant of Crompton-Howell cells, having a capacity of 800 ampere hours.

From the dynamo-room, test wires lead to the electrical and magnetic laboratories on the floor above, one of which is located directly over the dynamos and the other, where the most delicate instruments are kept, is at the end of the building. Among the instruments are a complete set of Weston voltmeters and ammeters, two Cardew voltmeters, four d'Arsonval galvanometers, two dynamometers, two Kelvin electrostatic voltmeters, two Kelvin electric balances

View in Electrical Laboratory, Engineering Building.

and a variety of instruments for special purposes, such as measuring the coefficients of mutual and self-induction. There are also resistance coils and the other apparatus needful for the complete equipment of the laboratories.

The Physics Building is a stone edifice of five stories, each with an area of 8,000 square feet, and is handsomely finished in hard wood. It contains an elementary laboratory nearly 60 feet square, large special laboratories for advanced work in heat, magnetism and electricity, rooms for optical work and photography, and two large laboratories for research. Connected with these are separate rooms for private work or special investigations. In this building are placed the most delicate instruments, for it is here that the exact measurements are made and delicate researches undertaken. An important feature is, that the building is some 400 yards distant from the Engineering Building, where the dynamos and other heavy machinery are located, thus securing for the delicate instruments entire freedom from the disturbing influence occasioned by such machinery. Current for lighting and experimental work is transmitted from the Engineering Building by cables.

The laboratories for research and exact measurement are on the first and second floors at one end of the building, and in order to avoid any magnetic disturbances, no iron nails or other materials of iron enter into the construction of this portion of the building. Brick piers set on a firm foundation of "hard pan" extend in pairs through the laboratories on the first floor to those on the floor above, where they are capped with slate slabs, thus forming tables which are entirely free from vibration. Similar tables are made in the laboratories below by placing slabs of slate between each pair of piers. Electric circuits and ground wires extend throughout the building so that an instrument in one laboratory may be connected with one in another room or with the ground. Currents of different strength are supplied by circuits with conveniently located terminals.

Besides a lecture-room for mathematical physics with its apparatus room, there is a large lecture theatre with a preparation room located directly in the rear connected with a large apparatus room. Apparatus may here be

fitted up and experiments prepared for the leture-room. The demonstration table is set on independent brick piers so as not to be affected by vibration, and has every convenience for experiments. The lantern for projection is a very fine instrument and is similar to the one recently made for the Royal Institution in London. It has three fronts adapted for optical, microscopic and diagrammatic work and is very easily manipulated. Light is supplied by a Brockie-Pell arc lamp. At one end of the room stands a large Wimshurst induction machine originally intended for the Chilian Government, but as they preferred to spend their money for fighting material, the machine eventually found its way to McGill University.

The equipment may be divided into three classes, as follows: Apparatus for illustrating lectures, simple forms of the principal instruments for the use of the students in practical work, and the most recent types of instruments by the best makers for special work or research. Among the latter may be mentioned a set of standards which is considered one of the best on this continent and which comprises 10 standards of one ohm and one each of 10, 100 and 1,000 ohms.

For comparing standards, there is a duplicate of the Fleming bridge used at Cambridge, England, the gift of the late Duke of Devonshire, the Chancellor of the University at that place. There is also the latest form of Carey-Foster bridge for standardizing coils and an instrument for ascertaining the conductivity of copper wire by comparison with a standard of pure copper wire. There are many very fine sets of resistance coils and Wheatstone bridges of the dial and other patterns, besides a complete set in platinum-silver for exact measurements. It is important to note that all these are standardized in true ohms, as agreed upon by the British Association at their meeting last August.

The collection of galvanometers comprises some thirty instruments of the most recent types for exact work by such makers as Elliott, Nalder, Hartmann & Braun, Wiedemann, Edelmann, and others. The only commercial instruments are a few Weston voltmeters and ammeters, for the practical work is done in the Engineering Building which has its separate instruments.

Among the photometers are portable and bench forms by Lummer-Brodhun and a spectro-photometer by means of which the relative intensity of two sources of light of different color may be ascertained by comparing them wave length by wave length. The University is also the fortunate possessor of two of Ewing's magnetic curve tracers which are believed to be the only ones on this continent. These instruments represent graphically the magnetic curve, or cycle, of a piece of iron subjected to the magnetizing action of an alternating current and created quite a sensation when recently exhibited by Prof. Ewing.

This description of the laboratories and their equipment is necessarily incomplete in many details and is only intended to give an idea of some of their special features. In conclusion, it should also be stated that the other laboratories of the Physics and Enginering Buildings are equally, if not better, equipped with instruments, etc.

The course in electrical engineering is one of the departments of the Faculty of Applied Science of which Prof. Henry T. Bovey is the Dean, and Prof. Charles A. Carus-Wilson, the Professor of Electrical Engineering. The department of experimental physics is under the direction of Prof. John Cox.

An attempt to obtain uni-directional from alternating currents, satisfactory enough to enable the rectified current to charge a storage battery, has been made by M. Pollak, who has communicated his results to the Académie des Sciences. M. Pollak uses a synchronized commutator in conjunction with an interrupting device for preventing discharge from the storage battery when the rectified voltage falls below that of the battery.

SAFETY DEVICE TO PREVENT DANGEROUS RACING OF CORLISS ENGINES.

BY

H. M. Stieg

Automatic engines as a rule have small and relatively very strong fly wheels, and any accident to the governor is usually tided over by the engine until the steam can be shut off. The construction too, of the automatic governor would assist in choking down the speed. With an engine of the Corliss type, however, the belt-actuated governor is a source of danger; the safe running of such an engine being dependent on the strength of this governor belt and its joints, to say nothing of the risk that the belt will leave the pulley. The fly wheel on this style of engine must of necessity be proportionately very large to compensate for slow speed, and from its size and construction it presents two sources of danger, namely, great inertia and a jointed structure.

If the statistics of the larger power plants for the past few years be examined, the conclusion is evident that the number and severity of the ruptures of fly wheels equals, if not exceeds, those of boiler explosions, and the reason seems not far to seek. So weak a construction as a large jointed fly wheel would not be tolerated in boiler construction. Within the past few months several such destructive accidents have occurred, and in each case the engine was driving dynamos at the time. In the last casualty, that of the fly wheel at the Cyclorama of the Chicago Fire, at Chicago, the loss in property was heavy, and but for the presence of mind of the engineer, loss of life would doubtless have resulted. But the strangest phase of the question is that one sees only occasionally any kind of provision for averting this, confidence seemingly being placed in the belt and the ability of the engineer to get his engine under control.

In case the engine is used for driving dynamos, an analysis of what would occur were the belt to break might point out a method for promptly stopping the engine automatically. In all cases except where there is an extreme overload, the immediate effect of the breaking of the belt, is to promptly increase the speed to a dangerous point; as a result, the potential is increased in nearly the same ratio. If the dynamo be of the constant current type it is an increase of its ampereage that is of consequence, while with other types it is the voltage. In any case this increase may be employed to promptly close a throttle on the steam pipe and thus avert a calamity. Quite a number of devices for accomplishing this will suggest themselves, but it is evident that such a device must be simple and prompt in its action, and, above all, not liable to get out of order. Some suitable form of balanced valve should be employed, that can be closed promptly, requiring but little power to operate it. It may be worked by either a lever or a stem with coarse threads moved by a sprocket wheel.

Suppose that the latter is used and is worked by a small motor geared to it by a chain. The motor may be either series for arc currents or constant potential for incandescent or power circuits. In any case it should be wound so as to carry a larger current than the normal for a short time, to meet extreme cases. The controller proper may be a solenoid, placed in multiple or series, this again to be dependent on the current. The form best adapted to the purpose would be that resembling the wall controller of the Thomson-Houston arc system, as the weighted core, partly balanced by a spring, admits of a wide range of adjustment. A suitable form of contact may be attached to the core and the device is complete. The apparatus can then be adjusted to any desired excess of pressure and when this is reached the motor circuit will be closed; the motor,

in turn, closing the steam valve, will automatically prevent the engine from attaining a dangerous speed. To insure that the whole train be kept in prompt acting condition it could be employed daily in shutting down by the use of a switch throwing one section of the magnet winding in multiple, and so increasing the current through it.

Should this arrangement of controller and motor be thought too complicated, a magnet and weighted lever valve could be substituted for it. The action of the magnet would release a detent on the weighted lever of the balanced valve, which, under the action of gravity would promptly close off the steam.

FORMULÆ FOR CALCULATING FIELD MAGNET WINDINGS.

BY A STEAM ENGINEER.

The fact that an armature coil traversed by a current of i amperes and of a size to enclose B lines of force is pushed along its circular path, as if driven by the crank of an engine having two centimetres stroke, an infinite length of connecting rod, and $\frac{Bi}{10}$ dynes total effective piston pressure, furnishes a method by which the proportion and size of the rotating and pushed organ of a dynamo electric engine may be determined.

The strength of the abutment or enclosure to confine and direct the magnetic fluid pressure is correctly calculated as that of a cylinder of two inches diameter and l inches long. In ordinary fluid engines we use a metal of sufficient tensile strength; in a magnetic fluid pressure engine we enclose it with metal, preferably copper, traversed by an electric current. The current density in this case, instead of the tensile strength, as for cylinders confining gaseous or liquid pressure, limits the pressure which can be carried. We may assume as an average current density 1,430 amperes per square inch. One square inch of such electric copper will safely confine a free pressure of 4,600 lines per square inch in air. In soft iron this pressure is reduced from B lines in iron to $\frac{B}{\mu}$ free lines in air; μ, which, gives this ratio for different values of B being the coefficient of permeability.

To find the section a, of the body of a cylinder of two inches diameter and l inches length to withstand a given fluid pressure we have the well-known formula.

2 × thickness × admissible strain = diam. × pressure ; from which we find for two inches diameter :

$$\text{A)}\ l \times \text{thickness, (or section of metal)} = \frac{l \times \text{fluid pressure}}{\text{admissible strain}}.$$

The same formula will apply correctly to the calculation of the electric copper required to enclose a given magnetic fluid pressure. We know by experiment, that the admissible strain of magnetic pressure for copper of 1,430 amperes current density per square inch is 4,600 lines. The magnetic fluid pressure is $= \frac{B}{\mu}$ and the length l is the length of the magnetic circuit.

Substituting these values in A) we have :

$$\text{B) Section of copper} = \frac{B\,l}{\mu \times 4{,}600}.$$

The same section will suffice to enclose any shape and size of core or reservoir confining magnetic pressure. The thickness of a wall around a reservoir, or the section of braces per unit of surface of enclosure, does not depend, as is well known, on the total capacity, but on the surface pressure.

The Eickemeyer motor described as an illustration of the method of calculating the armature in my previous article[1] will also serve as a simple case for determining the copper required for the field. In such a motor leakage, cross-magnetization, demagnetization and other irregularities of the magnetic field are practically eliminated and we need only consider:

The cast iron circuit, where $B = 40{,}000$; $l = 47$; $\frac{B}{\mu} = 140$.

The armature, where $B = 60{,}000$; $l = 8$; $\frac{B}{\mu} = 30$. The gap, where $B = 30{,}000$; $2\,l = 0.53$.

From formula B) we find the copper

$$\text{for cast iron circuit} = \frac{140 \times 47}{4{,}600} = 1.425 \text{ sq. inch;}$$

$$\text{for armature circuit} = \frac{30 \times 8}{4{,}600} = .\ 0.052$$

$$\text{for air gap circuit} = \frac{30{,}000 \times 0.53}{4{,}600} = .\ 3.46$$

Total = ... 4.937 sq. inch.

Further particulars are now easily obtained:

1. Ampere turns: Section × Current density = 4.937 × 1430 = 7050 ampere turns.

2. C_t or field current

$$= \frac{\text{ampere turns} \times \text{average length of coil}}{1{,}000 \times E.}$$

C_t for 220 volts and average coil length of 68 inches,

$$= \frac{7{,}050 \times 68}{220 \times 1{,}000} = 2.17 \text{ amperes.}$$

3. N = total number of lines in field $= \frac{2\,p\,L\,d^2}{r\,d}$ = 5,800,000 lines.

4. Diameter of field wire from formula:

$$\frac{\text{Current density}}{1.28}\left(\frac{d_m^2}{1{,}000}\right) = C_t = 44 \text{ mils.}$$

5. Resistance of this coil from

$$\frac{\text{resistance} \times d_m^2}{\text{average length of coil} \times \text{turns in feet}} = 10.7.$$

6. Weight in pounds,

$$\text{Wt} = \frac{\text{length of coils in inches} \times \text{section}}{3.12}.$$

7. Cooling surface, allowing 2½ square inches per watt

$$= \frac{\text{Section} \times \text{average length of coil in inches}}{0.29}.$$

8. Lost watts

$$= \frac{\text{Section} \times \text{average length of coil in inches}}{0.72}.$$

9. Lost watts are also $= \frac{\text{weight in pounds}}{0.23}$.

1. The Electrical Engineer, July 5, 1893.

TELEPHONE METER.

The question has often been discussed as to the utility of having a meter which should indicate the length or number of conversations by telephone, and should thus allow the telephone companies to charge their subscribers according to the use of the line. Messrs. Mix and Genest, the well-known constructors of telephonic apparatus, of Berlin, have recently constructed an hour meter of this kind. It consists of a simple clock, whose pendulum or escapement is released when the telephone is taken from the hook, so that is goes only when conversation is being held. A special signal shows when the clock requires winding. If the clock runs down, the subscriber cannot make use of the telephone as the line contact is not made.

A STUDY OF THE SOURCES OF ELECTRICAL ENERGY.[1]—II.

BY

Francis B. Crocker

In addition to the very objectionable indirectness of the present method of generating electricity with the steam engine and dynamo there is a theoretical limitation to the efficiency of a heat engine which is still more serious. The greatest possible efficiency of any heat engine is expressed by the formula, $E_\pi = \frac{T_1 - T_2}{T_1}$, in which T_1 is the initial absolute temperature and T_2 the final absolute temperature. This formula is derived from the second law of thermodynamics and signifies that if steam or hot gases enter the cylinder of a heat engine and begin to act at a temperature T_1 and cease to act and pass out at a temperature T_2 then the maximum possible efficiency of that engine is given by the formula. For example, an ordinary non-condensing engine receiving steam at 80 lbs. pressure which is equivalent to a temperature of 162° C. and exhausting or giving out steam at the atmospheric pressure of 15 lbs. equivalent to 100° C. would have an efficiency $= \frac{(273 + 162) - (273 + 100)}{273 + 162} = 14\frac{1}{4}$ per cent. This efficiency is theoretical and takes no account of friction, radiation of heat, cylinder condensation and other losses and must therefore be still further reduced in order to represent the actual or net efficiency given by the engine. These losses often amount to a large fraction of the total theoretical power of the engine. Assuming, therefore, that the theoretical efficiency of a given engine is 15 to 20 per cent., as calculated by the above formula, then the actual commercial efficiency will be in the neighborhood of eight to 12 per cent. As a matter of fact these figures are approximately the theoretical and actual efficiencies given by good steam engines in ordinary practice. Another way to arrive at this same fact, and one which is more concrete, is to compare the actual consumption of coal per horse-power hour with the amount of coal that would be required if the entire energy were converted into mechanical work. The amount of heat energy produced by the complete combustion of one pound of good coal is about 7,500 heat units which is equal to about 10,000,000 foot pounds which would give one horse-power for five hours; consequently the amount of coal required per one horse-power hour is only .2 lb. The actual consumption of coal in a very good steam engine is two lbs. per horse-power hour and much more frequently three or four lbs. or even more; hence the actual consumption of coal is 10 to 20 times the theoretical amount which would be required if all the heat were converted into mechanical power. The simple reason why the theoretical efficiency of a heat engine is ordinarily far below 100 per cent., even without taking account of friction, etc., is the fact that a great deal of the heat energy of the steam or gas passes out of the cylinder in the exhaust and is not converted into mechanical energy. It is analogous to the case of a water-wheel which only utilizes a small fraction of the total fall or head of water. This fact is clearly shown by the formula given above in which T_2 represents the temperature of the out-going steam or gas. If this temperature were absolute zero (—273° C.) then the efficiency would be 100 per cent. If on the other hand the temperature T_2 is considerably above absolute zero, then the efficiency is correspondingly reduced below 100 per cent. As a matter of fact the temperature of the exhaust of non-condensing engines is at least 100° C. or 373° absolute, and in the case of condensing engines T_2 is about 300° to 325° absolute. Now, it would not seem to be possible to reduce these temperatures further, for the simple reason that a non-condensing engine cannot have a temperature in the exhaust below boiling point and the temperature of water for condensation cannot be below freezing, and is usually considerably above that point. The inference would therefore be that the only practical method of improving the efficiency of a heat engine is to raise the initial temperature at which the steam or gas enters the cylinder or begins to act. In point of fact this is the way that the efficiency of heat engines has been, and is now being, increased. In the time of James Watt very low steam pressures were employed, usually about five or ten lbs. per square inch, and before the time of Watt even lower pressures, of two or three lbs., were employed. These low initial pressures, and therefore temperatures, necessarily meant low efficiency and large consumption of coal per horse-power hour. Since that time steam pressures have been steadily increased until we now have 150 or even 200 lbs. pressure on very fast passenger or war vessels. Indeed the principal improvement of the steam engine during the present century has been the increase of steam pressure and the necessary strengthening and modification of the boilers and engines in order to stand these high pressures which not only greatly augment the efficiency, but also produce much more power in the same size of engine.

Of course great difficulties are encountered in largely increasing the pressure. In the case of the steam boiler there are at least two serious obstacles which are apparently inherent and almost insurmountable. The first of these is the fact that the thickness of the boiler upon which its strength largely depends, cannot be very much increased without reducing the passage of heat through it and without having an enormous weight and cost of the boiler, the surface required being large. There are also practical difficulties in the construction of a boiler of very thick metal. A still more serious difficulty is the fact that, as the pressure and therefore temperature of the steam are raised, a point is finally reached at which the strength of the boiler begins to be reduced by the heat and would not permit further increase.

In this respect the gas engine apparently possesses great advantages over the steam engine in its possible ultimate efficiency, for the reason that the high pressure and temperature are produced directly in the cylinder which can be made of almost unlimited thickness since it is comparatively small and the heat does not have to be transmitted through its walls. In this way we entirely eliminate the steam boiler which is the chief limitation to the increase of steam pressure. It cannot be said that the gas engine has as yet realized much of this great advantage over the steam engine. It is probably a fact, however, that there are gas engines working to-day of which the theoretical and actual efficiencies are higher than those of the best steam engines. Prof. Unwin states in his lecture before the Society of Arts, Jan., 1893, that gas engines have already given a thermal efficiency twice that of large steam engines. Prof. Ewing[2] has pointed out that the theoretical efficiency of the gas engine would be 87 per cent. if the initial temperature were that of combustion and the final temperature that of the ordinary atmosphere. Previous compression of the gas would, of course, be necessary, and all friction and other losses would have to be eliminated. Assuming, however, that these losses amount to 50 per cent. of the theoretical power of the engine, an actual efficiency of $43\frac{1}{2}$ per cent. could still be obtained which would be at least four times the net efficiency of the best steam engines of the present day. The present gas engines have several practical difficulties and will have to be radically improved before very high efficiencies can be secured, but they seem to possess the possibility of efficiencies much higher than those of the steam engine. To show that a very high

1. Extract from a forthcoming treatise on Electric Lighting, by the same author.

2. Article on "Steam Engine," Ency. Brit., 1889.

efficiency is not entirely visionary, we can refer to the cannon which is really a gas engine since it converts heat energy into mechanical energy. Prof. Thurston states that a cannon actually has a thermo-dynamic efficiency of about 50 per cent.[3]

The hot air engine has been developed by Ericsson and others, and is both safe and convenient, but it is far inferior to the internal-combustion gas engine in actual as well as theoretical efficiency and output.

The remarkable increase in economy which has been secured during the last few years by the use of compound, triple-expansion and quadruple-expansion steam engines for both marine and land work, might lead one to imagine that this improvement can be carried on almost indefinitely. As a matter of fact, however, compound engines are just as surely limited in their theoretical efficiency as the simple engine. Their efficiency depends upon the initial and final temperatures of the steam as expressed by the formula discussed above, just as truly as in the case of any other heat engine. The greater economy of compound engines is largely due to the reduction of cylinder condensation by avoiding large ranges of temperature in any one cylinder. This simply means that the simple engine would have larger losses and its actual efficiency would be much less than the theoretical, whereas in the case of a compound engine the actual efficiency would approximate more closely to the theoretical. Compound engines thus enable higher pressures to be used without having the great losses due to cylinder condensation which would occur in simple engines. It has been shown above, however, that apparently there are practical limits to the increase of the initial temperature, and even if the boiler could be kept at a red heat the theoretical efficiency of the steam engine would only be about 60 per cent. and the actual efficiency of course considerably lower.

The idea of substituting other fluids for water in boilers and engines is fallacious, both scientifically and practically, and gives no hope of increased economy in the production of power. The same inexorable law of thermo-dynamics prevents the efficiency being made higher except by either increasing the initial temperature or decreasing the final temperature. Bi-sulphide of carbon, ether and other volatile fluids, instead of water, have been tried again and again by inventors either from ignorance or intention to deceive. It is perfectly obvious, however, that the substitution of these liquids cannot help to secure a higher initial temperature; in fact, it would rather tend to increase the difficulty and produce still more disastrous results in case of an explosion. To be sure, the final temperature of a non-condensing engine using ether instead of water would be 310° absolute instead of 373°, but this slight difference would be more than outweighed by the practical difficulties of using ether instead of water. In the case of a condensing engine the final temperature would be practically the same, whatever liquid be employed in the boiler.

The heat engine considered from all these points of view does not seem to afford much encouragement for high efficiency in the conversion of the fuel energy into mechanical energy, except perhaps in the case of the gas engine, which, however, still needs radical improvements. Moreover in the generation of electrical energy the production of mechanical energy is merely a step and the dynamo must be used to convert the mechanical into electrical energy, and although the electrical engineer can proudly say that the dynamo is the most efficient and the most perfect machine in existence, nevertheless our present method of producing electricity by means of a boiler, steam engine and dynamo is very indirect and complicated. The dream of the electrical engineer and scientist has therefore been to convert the energy of fuel directly into electrical energy, but as yet little or no practical progress has been made in this direction. It is possible, of course, to burn coal, gas or other fuel and use the heat produced, in a thermo-electric battery to generate electric currents; in simplicity, this process is all that could be desired since there is only one simple apparatus without any moving parts, which is as harmless and easily taken care of as an ordinary stove, but unfortunately the efficiency is very low; in fact, it is limited by the same law as the heat engine, and is expressed by the same formula, $\frac{T_1 - T_2}{T_2}$, in which T_1 and T_2 are the temperatures of the ends of the elements. The possible differences of temperature between the ends would not seem to be so limited as the possible temperature of a steam boiler. There are, however, many practical difficulties in maintaining one end of the elements at a very high temperature and the other end at a low temperature, and great trouble has been found in making perfect joints between dissimilar metals which would not crack after repeated heating and cooling.

3. *Science*, Oct. 31, 1891.

Many persons think that there is an inherent deterioration of a thermo-electric battery which necessarily occurs after any considerable period of action. The writer has made numerous experiments in connection with these batteries and has seen some of them which have been in use several months almost continuously giving a fair output of .05 volt *external* potential difference and 5 amperes per element (1 x 1 x 4 inches), without any apparent diminution in activity. There would seem to be no reason why there should be any such inevitable deterioration beyond the fact that it is difficult to make a permanent joint between dissimilar metals, as already stated. This difficulty can be, in fact it has been, overcome by proper mechanical design and construction. The real difficulty is the low efficiency and small output of thermo-electric batteries. Probably the best results so far obtained do not give an efficiency over one or two per cent., that is, not more than one or two per cent. of the heat energy is converted into electrical energy and probably the best output so far obtained is that stated above.

This efficiency is of course extremely low, but the simplicity and directness of the process would make up for a considerable sacrifice in efficiency, provided it is practical in other respects. The output is very small, but a comparison shows that a 25 h. p. plant consisting of boiler, steam engine and dynamo would occupy a space about 30 x 30 feet and 10 feet high, and a thermo-electric plant of the same generating power would occupy a room 20 x 20 feet and 10 feet high. In short, the thermo-electric battery is by no means utterly unpractical even at the present time, and it possesses great possibilities of future improvement, and though it might not compete with the present method for large central stations, it is certainly admirably adapted to small isolated plants where its simplicity, safety and ease of attendance would be of the greatest importance. The lower efficiency would be of small consequence compared with these other advantages. There are probably fewer serious difficulties in the case of thermo-electric batteries than in the case of secondary batteries, and the same amount of time, money and scientific ability which have been expended on the latter would probably bring the former to a fair state of perfection and would certainly make them applicable to a great many useful purposes.

The thermo-magnetic or pyro-magnetic generator has been experimented upon by Edison and others. In 1887, Edison constructed both generators and motors of this kind. The action of this form of electric generator depends upon the fact that iron or nickel lose almost all their power to conduct magnetism when heated to a certain temperature. If therefore a core of iron surrounded by a coil be connected to a magnet by means of thin strips of iron or nickel, a current is generated in the coil of wire when the strips are alternately heated and cooled, because the lines of force are first alternately cut off, then allowed to pass, and so on. This machine has the same disadvantages as the thermo-electric battery, being low in efficiency

and requiring a large apparatus for a comparatively small output. Nickel has usually been employed instead of iron as the material to be alternately heated and cooled, for the reason that it loses its magnetic conductivity at a lower temperature than iron, this point being 310° C., but nickel, of course, has considerably less permeability than iron and, therefore, although the required range of temperature is less, the amount of magnetism is also less. Furthermore, as has been pointed out by Prof. Anthony, the second law of thermo-dynamics applies to this apparatus, as, in fact, it does to all apparatus for converting heat energy into any other form of energy; therefore, to obtain a high efficiency we must have a great range in temperature. Theoretically it might therefore be better to employ iron instead of nickel since its point of practical loss of permeability is 785° C.

ACTION OF ELECTRIC DISCHARGES ON OXYGEN.

An apparatus for studying the action of the electric discharge on oxygen was shown by Mr. W. A. Shenstone and Mr. M. Priest at the recent Royal Society Soirée. The oxygen is confined in the annular space between two glass tubes, the inner and the outer surfaces being kept at a low temperature, about 1 deg. Cent., by means of freezing mixtures. These surfaces also form two non-metallic electrodes, the liquids being connected to the terminals of an induction coil. The effect of passing the current is to heat the oxygen, which is immediately cooled by the refrigerating surfaces, and a part of the oxygen transformed into ozone. It is suggested that the heat dissociates the molecules (O_2), and in cooling some of the atoms unite in such a way as to become ozone (O_3). The process cannot be carried beyond the point when some 17 per cent. of the oxygen has become ozone. The apparatus is provided with means for determining the conditions of experiment. The make and break of the coil is operated mechanically, so as to give a determinable frequency. The difference of potential is regulated by a spark gap between two discs, and the yield of ozone is measured by connecting the oxygen tube to a mercurial pressure gauge. To prevent the ozone causing the mercury to stick to the glass, as is its wont, the connecting tube is kept heated to about 300 deg., with the result that any ozone that enters it immediately returns to its previous condition of oxygen. It is found that high potential differences and high frequencies are prejudicial to the formation of ozone, and that under equal conditions a coil is more effective than a Wimshurst or Voss machine.

TESTS FOR INDIA RUBBER.

A series of tests have been recently carried out by a Russian naval officer at the St. Petersburg Technical Institute in order to establish a set of definite rules for judging the quality of vulcanized india rubber. The following, in brief, are the conclusions arrived at, recourse being had to physical properties, since chemical analysis did not give reliable results: 1. India rubber should not give the least sign of superficial cracking when bent to an angle of 180 degrees after five hours of exposure in a closed air bath to a temperature of 125 degrees C. The test-pieces should be 2.4 inches thick. 2. Rubber that does not contain more than half its weight of metallic oxides should stretch to five times its length without breaking. 3. Rubber free from all foreign matter, except the sulphur used in vulcanizing it, should stretch to a least seven times its length without rupture. 4. The extension measured immediately after rupture should not exceed 12 per cent. of the original length, with given dimensions. 5. Suppleness may be determined by measuring the percentage of ash formed in incineration. This may form the basis for deciding between different grades of rubber for certain purposes. 6. Vulcanized rubber should not harden under cold. These rules have been adopted for the Russian navy.

REFLECTION OF ELECTRICAL WAVES IN WIRES.

Wiedemann's Annalen for May contains a paper by Herr J. von Geitler on the reflection of electrical waves in wires. The waves were generated by means of the arrangement used by Blondlot, the secondary circuit being connected to two parallel wires 280 metres long. The variation of potential along these wires was measured by means of a differential electrometer, consisting of a double aluminum needle suspended by a quartz fibre before four metallic plates. These plates were connected, two and two, to the parts of the wire whose difference of potential had to be measured, in such a way that the attraction between the pairs of plates tended to turn the needle in opposite directions. The experiments show that if a series of electrical waves travel along two equal and uniform parallel wires there is a regular loss of phase and partial reflection wherever the parallelism of the wires is destroyed, or wherever there is a change in the diameter of the wire. The same effect is produced by joining the plates of a condenser to the two wires at any point. The curves showing the connection between the electrometer throw and the length of a branch circuit attached to the main wires are of a very curious form, and owing to the loss of half a wave length at the reflection at the end of the branch circuit in one case, the curve obtained when the ends were separate was the exact inverse of that obtained when the ends were joined together.

DEPOSITING COPPER WITH HIGH CURRENT DENSITY.

A very suggestive exhibit, and one full of promise, was that of Mr. J. W. Swan, shown at the recent Royal Society Soirée. He showed specimens of electrolytic copper, exceedingly hard, brilliant as mirrors, and yet deposited under a current density of 144 amperes per square foot. This astounding result is obtained by adding to the acid solution of sulphate of copper, a minute quantity of colloid matter, such as gelatine boiled in nitric acid. The specimens he exhibited had from two to 30 parts of syntonized gelatine, added to each 100,000 parts of copper solution, and the effect could be readily followed. The process is carried out at a temperature of 15 deg. to 20 deg. Cent., and the current is applied intermittently, 15 seconds on and 15 seconds off. If continuous, a coat of gelatine forms on the plate and insulates it. Sheets were shown as thin as paper; they had been stripped from the matrix of bright copper, and were exceedingly elastic, while their brilliancy was marvelous. Already the process has been applied to effect the bright deposition of nickel, and so dispense with the scratch-brush and burnishing processes.

A NEW STANDARD CONDENSER.

In the recently published number of the *Proceedings* of the Société Française de Physique there is an account of a standard condenser formed by two plates of silvered glass separated by three blocks of quartz accurately worked to the same thickness. The instrument almost exactly realizes a theoretical condenser, as the central part is only separated from the guard-ring by a narrow line along which the silver has been removed. The only disadvantage is that the insulation is rather bad, and when the air is not perfectly dry there is a small current between the central disc and the guard-ring. To get over this difficulty the author (M. P. Curie) joins the electrometer to the continuous plate of the condenser, charges the central disc of the other plate with the battery, and connects the guard-ring with the earth. Under these conditions the field of force between the plates is no longer uniform, but the charge of the condenser is the same as in the ordinary arrangement. With this arrangement the insulation is all that can desired, as the quartz blocks are very good insulators, and little affected by moisture in the air.

WORLD'S FAIR DEPARTMENT.

THE ELECTRICAL FORGING COMPANY'S WORLD'S FAIR DISPLAY.

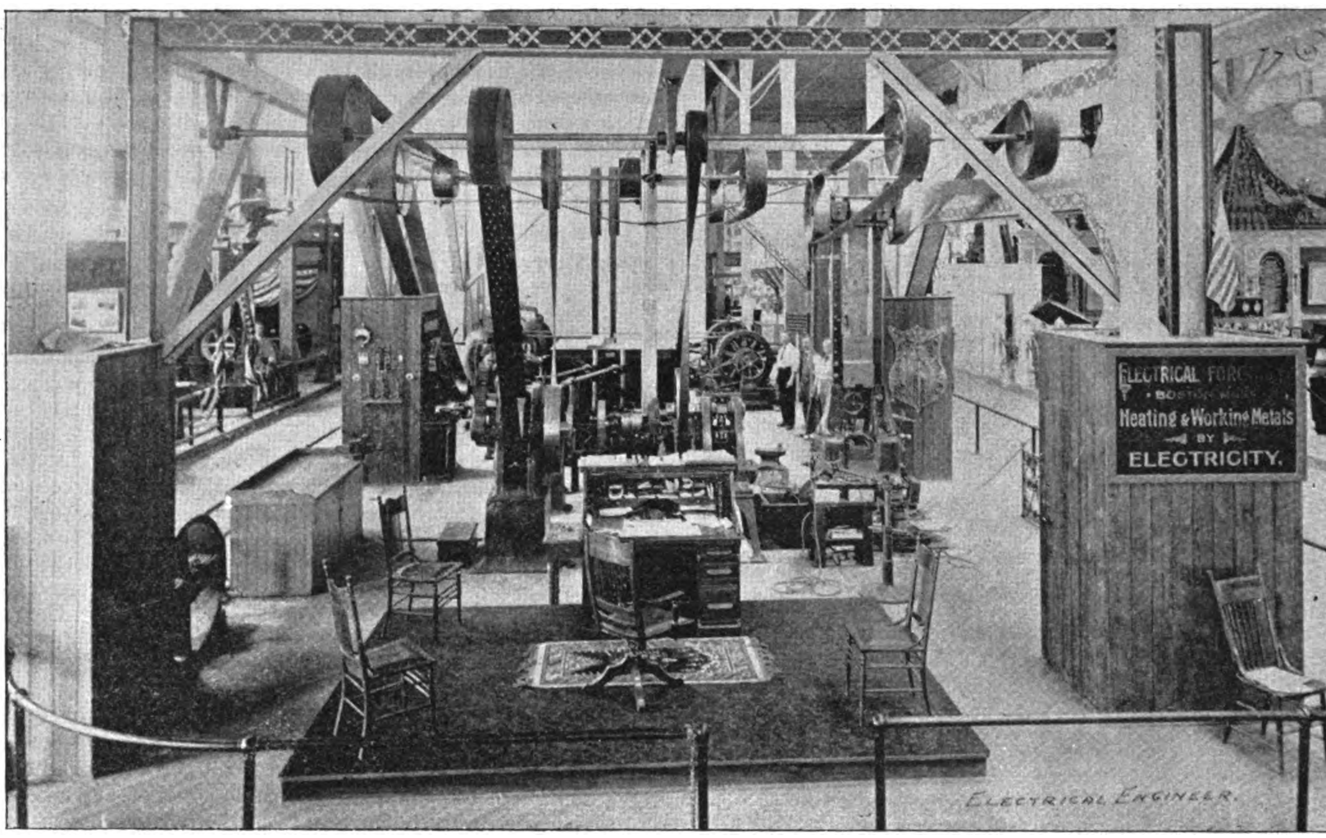
There is no more workmanlike exhibit in the Electricity Building than that of the Electrical Forging Company, of Boston, operating under the patents of Messrs. George D. Burton and E. E. Angell, and one or two others. The shop—it is more like a shop than a mere display of apparatus—is at the eastern side of the Hall north of the main east entrance, and well repays the study of anyone interested in this important class of work. The exhibit, in the first place, is not one of "still life" as are so many here, and no attempt at ornamentation has been made, but all the apparatus is running and showing what it can do. So much has been said on the advantages of performing this class of work by electricity that this article will be devoted simply to a description of the apparatus which speaks for itself. I only regret that patents now pending in foreign countries will prevent the publication of many interesting diagrams and details that would otherwise be given.

The generator supplying current for the work is of 75 h. p. specially wound, to deliver current up to 34 amperes at as high as 2,400 volts.

The accompanying diagram will serve to make clear the method of operation and the connection of the various devices.

The dynamo D has its fields energized by the exciter E, of 3 h. p., which is a shunt wound machine, exciting its own fields. This machine produces 220 volts and 6 amperes. The regulation is obtained by the rheostat R, which controls the heat at the terminals of the secondaries of the transformer C, and so minutely that a piece of metal can be raised to a white heat and maintained at that point for a great length of time with very little power.

The welding transformer C is constructed in a very ingenious manner. The core is composed of soft iron wire. About 800 pounds is used in this apparatus in small pieces, breaking joints, and uninsulated. P represents the primary coils. These coils, 12 in number, are grouped in six pairs.



The Electrical Forging Co.'s Heating and Metal Working Exhibit, World's Fair.

The individuals of each pair are connected in series, and each such pair is connected to the primary terminals joined to the alternating generator, and being thus operated in parallel.

The secondaries S are composed of copper spirals formed by casting. There are 12 of these castings, one end of which is bolted to the positive ring R and the other end to the negative ring R'. These rings are composed of copper, and weigh about 800 pounds each. To these rings are bolted the metal holders, one upon each ring. The bar or rod B is placed between the holders and completes the circuit between the two poles.

This machine will heat a bar three inches square and three feet long in eight minutes with an expenditure of 75 h. p. One important feature claimed to be possessed by this process alone is the heating and working of copper, brass, iron, steel, German silver and lead simultaneously with the same apparatus, at the same or at different points on the transformer. Eight distinct forges can in this way be operated at the same time with different metals or dif-

ferent sizes of the same metal. A cold bar may also be inserted without withdrawing others that may be in process of heating, and one bar, having become sufficiently hot, may be removed without disturbing the others, the machine automatically regulating itself to the changes of load.

All sorts of forging and other metal work are carried on to show the possibilities of the mechanism. Among the apparatus used are rolling machines for round and irregular shapes from one to one-eighth of an inch in thickness, and a number of drop presses. The liquid rheostat, now used in connection with metal working by the arc, is shown. This consists merely of a metal-lined tank containing the liquid and a fan shaped metal plate dipping into it to a greater or less depth as the nature of the work requires. This device is found to be more satisfactory than the wire resistances heretofore employed and costs about one-tenth as much. Samples of forging, welding, brazing, etc., by the various processes are shown.

Not far from the transformer, the rolling mills and the presses, stands a wooden bucket with a plate of lead hooked over its edge and extending into about six quarts of solution of common washing soda in water. To the lead piece is connected one terminal of a direct current generator while the other goes to a pair of blacksmith's tongs, with well insulated handles, in which the work is

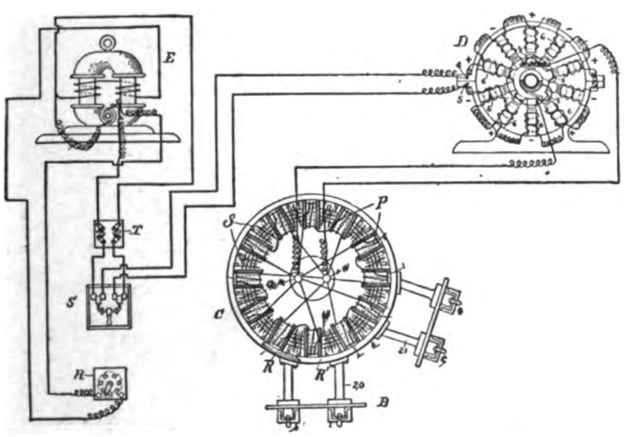


Fig. 2.—Arrangement of Welding Dynamo and Transformer.

held. With 45 volts and 40 amperes of current a piece of iron one inch square held in the tongs and dipped three inches into the solution is heated to the melting point throughout the submerged portion in two minutes, while the bar may be held in the bare hand without discomfort two inches from the melted part. During the passage of the current, electrolysis takes place, surrounding the heated bar with a hydrogen jacket and liberating oxygen at the lead plate. For other metals, other solutions are used and sometimes it is found advantageous to employ other than lead plates.

The exhibit seems to be one of the most successful and popular in the building and is always surrounded by a curious and interested crowd. The spectacle of a cold bar of metal heated red hot by being plunged into a bucket of water and then cooled by being dropped back into the same bucket is a constant source of amazement to the uninitiated, while "those who know" cannot fail to be impressed with the simplicity and novelty of much of the apparatus displayed as well as the perfection of the work. Mr. George D. Burton is himself in charge of the exhibit.

The World's Fair was closed on Sunday, but it is understood that the many good Americans who keep Sunday religiously on some other day than Sunday will take action. They object to a Fair which is only open to them five days out of the seven, and say that when it comes to avoiding any pain to religious sensibilities, the Fair really ought to be closed every day in the week.

ADDITIONS TO THE ELECTRICAL JURY.

Since the publication of the list of electrical jurors in The Electrical Engineer of last week, the names of five new members for the United States have been added. These are: William Shrader, University of Missouri, Columbia, Mo.; Dugald C. Jackson, University of Wisconsin, Madison, Wis.; S. Brown Ayres, Tulane University, New Orleans, La.; S. Tompkins, Clinton College, Fort Hill, S. C.; Ralph W. Pope, Secy. Am. Inst. Elec. Engrs., N. Y. The jury has elected as its president, Prof. Henry S. Carhart, and as secretary, Mr. W. E. Anderson of the Department of Awards. There will be two vice-presidents.

MESSRS. FELTEN AND GUILLEAUME.

There appears to have been some misunderstanding and error in regard to the policy of Messrs. Felten and Guilleaume as to their exhibit in the Electricity Building. Mr. G. A. Schmidt, their representative at the Fair, had, it appears, received instructions to write no articles himself for the papers, but says that both he and his firm are and always have been quite ready and even anxious to furnish such data for publication as may be desirable. The unfortunate Tower of Babel incident of remote date is responsible for the misapprehension on this subject.

WORLD'S FAIR NOTES.

Prof. A. G. Bell was in Chicago during the week as an attendant at the Congress of instructors of the deaf. It is well known that of late years Prof. Bell has taken greater interest than ever in this subject, and may be said to devote his life to it, even to the neglect of electricity. He read a paper before the Congress.

Owing to the recent reductions in railway rates, the attendance at the Fair is increasing very quickly. The number of visitors for July already equals the number for May and June combined. The coming month of August with its numerous congresses promises to see very large crowds. But there is abundant and comfortable accommodation for all, and the fact is now well-established that charges are moderate and fair.

It is an unfortunate thing that there should be so much trouble and friction between the Fair management and the foreign commissioners and exhibitors. The latest row is with Russia, whose representatives have covered up the Russian exhibits until an apology or reparation is given for some recent raid on an exhibit from St. Petersburg. These unpleasantnesses ought not to occur. It seems likely that France will have no jurors in the electrical section, or elsewhere.

Baurath Ulbrecht, of Germany, has been elected first vice-president of the Electrical Jury of Awards and Prof. Ayrton, second vice-president.

The night displays at the Fair will hereafter be limited to electricity. Fireworks will not be permitted on the Fair grounds, or they will have to be set off away from the buildings. A bomb which was sent up on the night of July 22 exploded before it had reached a great height, and the shell, falling on the Manufactures Building, crashed through the skylight and set fire to the curtain stretched below. Had it not been for the prompt work of the Fire Department, the building, and perhaps others, would have been consumed. Two firemen climbed 100 feet upon the big beams and tore down the burning cloth, extinguishing the flames, which had obtained considerable headway.

Mr. R. W. Pope, secretary of the American Institute of Electrical Engineers, writes that the facilities of the Institute headquarters at the Fair are highly appreciated by members and other visitors. Among those who were entertained last week were Profs. Ayrton, Jackson, Thomas, Owens and Dolbear and Dr. Emery.

THE EXHIBIT OF THE ELECTRIC APPLIANCE COMPANY, OF CHICAGO.

NEAR the southern end of the east gallery in the Electricity building is the exhibit of the Electric Appliance Company, of Chicago. This company has secured an excellent location, overlooking the main floor, and therefore, visible from nearly every part of the building. Their display is varied, and includes the apparatus of the several manufacturing concerns for which they are the Western agents.

Perhaps the most striking feature at the first glance, is the large sign made of six c. p. 50-volt Packard lamps, and controlled by a commutator switch. At the top is a representation of an incandescent lamp flanked on either side by a scroll, and below this is a board bearing the words "Packard Lamps." The switch is so arranged that the words are spelled out, the letters each appearing for a second and disappearing again until the last one of a word is reached, when the whole word comes back complete and the next is treated in the same way thus: P–a–c–k–a–r–d—Packard—L–a–m–p–s—Lamps—Packard Lamps. At the instant that both words appear together the ornamental scroll work and lamp at the top are also lighted for a few seconds and then it all begins over again. Additional interest is given by exposing the switch in the front showcase where its working may be seen by passers-by. It is worthy of note that, though this sign has been running since the Fair opened, only three lamps have burned out—and miniature lamps at that—a record many of their 16 c. p. brethren might envy.

The wiring throughout is of high grade Paranite. Current is received at 1,000 volts and is led to a Wright cutout box, made by the Hope Electric Appliance Company, of Providence, R. I., and thence to three Elkhart transformers whence it is delivered in one 100 and two 50-volt circuits for the lamps and motors. These transformers run from ten o'clock in the morning to ten in the evening, six days in the week, and have been giving the utmost satisfaction ever since they started.

The motors referred to are of the Meston type and form a conspicuous part of the exhibit, besides making it the coolest place in the gallery and a great resort for gallery gods and men on hot days. The fans are everywhere, on desks, tables, showcases and at the top of a high cone of many sizes of Paranite wire in the centre of the space. A sewing machine is also shown, run by a motor with its regulator attached to the treadle so that the speed may be varied by the foot, leaving both hands free for the work. The sample of work shown, however, seems to be an endless Chinese crazy quilt in a high state of excitement and is allowed to run through the machine at its own sweet will while the excellence of the motor's regulating device is exhibited. But this is a display of motors. The needlework exhibit is in another building.

At one side of the space is a board devoted to Whitney measuring instruments for both direct and alternating cur-

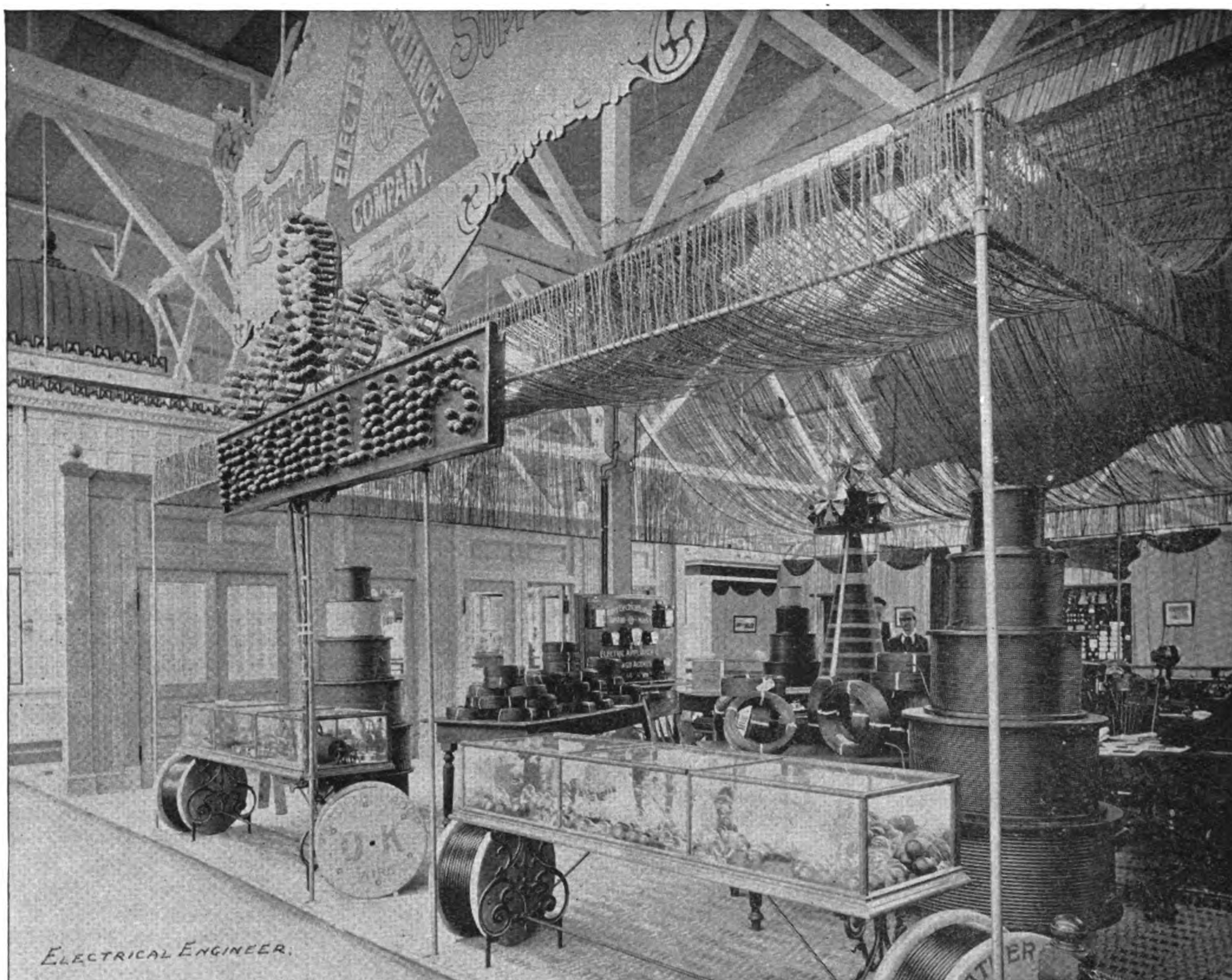


EXHIBIT OF THE ELECTRIC APPLIANCE CO., WITH PACKARD LAMP SIGN.

rents, prominent among which are the portable alternating current ammeter and voltmeter. In these instruments a change in the number of alternations does not affect the readings. They are made with mechanical aperiodic attachments to facilitate reading when the instruments are used for testing, or for mean readings where there is a variable current. This same attachment is also a feature of the direct current instruments.

The New England double pole snap switch is shown complete and also in all its parts, from 15 to 100 amperes, and also a case of the Consolidated Manufacturing Company's jack-knife switches ranging from 15 to 300 amperes in capacity. The "swinging ball" lightning arrester, also has a place here, and two more boards display Iona specialties, switches, sockets, cut-outs, and electric gas lighters, and a large collection of pliers, scissors, etc., for wiremen's use made by Vom Cleff & Co., of New York City. The show cases about the edge of the space contain instruments already mentioned and a large quantity of Packard lamps of all sizes and colors, and several pillars made of reels of Paranite wire complete the display. The pavilion roof, by the way, is made entirely of Paranite lamp cord of well chosen colors, the first ever made by this company.

Mr. F. S. Gassaway is in charge of the exhibit.

M Mascart, after a sojourn of a few days in Chicago, came East to New York last week and spent several days inspecting various electrical installations and factories in the city and vicinity. He returns to Chicago *via* Washington and Pittsburgh, for the Electrical Congress. He is delighted with what he has seen, and his only adverse comment on the Fair is that it is "too big."

EXHIBITS OF CHAS. A. SCHIEREN & CO., AT THE WORLD'S FAIR.

To visitors to the Centennial and Paris Expositions, as well as to all engaged in the electric light and power industries, the name of Chas. A. Schieren & Co. must be familiar. Their exhibits at the various expositions have attracted the attention of visitors and have been appreciated by the juries of award as shown by the various diplomas and medals received. Their exhibits at the World's Columbian Exposition are unique in design, and the construction of the booth, Section D, Space 3, Electricity Building, is worthy of a careful inspection. The method of constructing booths and pavilions of link belting has been studied with care and some very artistic combinations have been produced in these exhibits which display to good advantage the construction and general qualities of the leather and the finished belts. The firm has quite outdone itself in this respect in the booth on the east side of the Electricity Building. A classic structure has been erected with four square supporting columns made of the link belt, using black links for the ornamental figures and the Greek scroll around the cornice. The columns are surmounted by small pyramids of belting, and adorned with the Spanish colors and American flags. The huge bull's head with graceful and wide-spreading horns, which serves also as a trade mark, is erected directly over the entrance to the pavilion, and as the horns are each tipped with an incandescent bulb, the effect, joined with that of the light from the other lamps in each panel, is pleasing in the extreme.

Exhibit of Chas. A. Schieren & Co., at the World's Fair.

The interior of the booth is provided with chairs, tables, and a showcase containing numerous curiosities in belting, among which might be mentioned several old styles of

belt joints. One made in 1830 is laced and rivetted without cement, another of 1840 is rivetted and sewed, and various old style English joints are shown both sewed and rivetted. Several pieces of belting are shown constructed of narrow strips of leather laid side by side on edge and fastened together with steel bolts. Other styles of joints are exhibited,—the old laced joint, the joint made by fine wire lacing, and the cement. Over this case hangs a frame constructed of link belting, in which are contained the various medals received by the house for the superiority of their product.

At the left surrounded by a brass rail is the exhibit of link belts, by the American Leather Link Belt Company. It contains the diploma and bronze medal received at the Paris Exposition of 1889; also various coils of the belt. One large roll contains 100 feet of 36-inch belt 1-inch thick and others of 12, 11, 10 and 9-inch belt, all being $\frac{11}{16}$ of an inch thick and used for dynamo work are shown. Other coils fill out the geometric figures formed by those mentioned.

On the opposite side of the pavilion is the exhibit of "Perforated" and "Electric Belt," the several smaller rolls being grouped tastefully around one large roll consisting of a "Zulu" electric belt, 72 inches wide. A roll of 14-inch "Perforated Electric," one of 18-inch, and another of 16-inch are also shown. A fine photograph of the New York factory at 41–51 Ferry st. rests against this exhibit.

In Section F, Block 27, Machinery Hall, Schieren & Company have another beautiful display. A large square pavilion of ebonized wood, touched with gold leaf, and gracefully hung with linen velour curtains of old rose color, contains among other things a roll so large that one doubts if the wheel has yet been built that will support it. This is a three-ply belt, 200 feet long and 96 inches wide, and required the hides of 450 large steers for its construction. Grouped about it in graceful figures are rolls of the "Electric" and "Perforated Belt" similar to those described in the exhibit in the Electricity Building. In a show case at the left are samples of the company's patent round and twisted belting, and in another case at the right are exhibited belt lacings both in rolls and in bunches, tipped and plain. Belt dressing and coils of raw hide rope are also shown in the latter case. The names of the four principal offices of the company at New York, Chicago, Boston and Philadelphia, are displayed on tasteful signs on the front and back of this pavilion. Two diplomas received by the company at the Centennial and at Paris in 1889, adorn the walls.

THE SCHIEREN BELTING EXHIBIT IN ELECTRICITY BUILDING.

While the exhibit of belting at the Fair is large, Messrs. Chas. A. Schieren & Co. can be said to have held their own in all ways and may well be proud of the display. These pavilions do not contain all the belts of the firm at the Exposition. In Machinery Hall and the Electricity Building may be seen the Schieren belts in use on many of the various machines. Nearly all of the all-black belts in use at the Fair are of their make. The contracts from the Columbian Exposition Company amounting to over $8,000 are shown at the Chicago office of the company. Visitors at the Fair interested in belts and belting will derive pleasure from examining these exhibits.

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ELECTRIC RAILWAYS IN EUROPE.

WONDER has often been expressed at the apparent lack of appreciation, or, according to some, of enterprise in Europe, with regard to the electric railway,—an apathy which has resulted in the rather slow introduction of this method of propulsion notwithstanding its widespread application in the United States. While this slowness may be partly due to the two causes above mentioned, the fact must not be lost sight of that the methods and time required to obtain municipal concessions in this country differ radically from those in vogue abroad. Take, for instance, the case of England where, until the very recent organization of the County Councils, it was necessary to obtain an Act of Parliament to build an electric railway of any kind or size. Besides that, the legitimate cost of obtaining such an Act was often so high as to make it a not unimportant factor in the total cost of the proposed scheme. In spite of all this, however, it would be erroneous to believe that electric railroading has come to a standstill in Europe. On the contrary, indications are not wanting to show that Europe is gradually awakening to the importance and commercial value of electric railways, and, as showing the work which has already been done, we note an excellent statistical table which appears in a recent number of our French contemporary, *L'Industrie Electrique*. This table, printed below, gives a list of 60 roads in Europe in actual operation or in course of construction.

	Roads in Operaation.	Constructing.	Proposed.	Number of cars.	Miles of road.
Germany	14	....	2	248	91
England	15	1	....	96	50
Austria Hungary	8	....	....	74	15.5
Belgium	1	1	....	28	8.5
Spain	1	....	....	12	8.5
France	7	1	4	176	48
Italy	8	1	....	24	12.5
Holland	1	....	....	....	....
Russia	....	2	....	....	9.5
Sweden	....	1	....	22	4.7
Switzerland	8	....	....	53	17.5

Considered from the standpoint of miles of road and number of cars in operation, Germany stands well at the head of the list, exceeding England by nearly double the number of miles of road and by nearly three times the number of cars. France shows nearly the same number of miles of road as England but is far ahead in the number of cars. It is also interesting to notice the record of Switzerland, most of whose roads are operated by water power, and some of which are rack-railways. The extent of European electric railway work may be best expressed by referring to the fact that Boston alone has a greater electric railway equipment both in miles of road and number of cars, than the whole of Europe.

The influence of American practice is most marked in European electric railway work; indeed, of the 60 roads, no less than 25 are of the Sprague and Thomson-Houston systems. But while our neighbors across the sea may have made haste slowly, the work they have thus far accomplished has throughout been characterized by solidity of construction; and in this they have no doubt profited by the results of experience on not a few of our early roads, which in the course of time have had to be entirely reconstructed. We make no doubt, however, that once fairly begun, Europe will not be found lagging in electric railway work, and we discern in this new work a repetition of her experience with electric lighting, which at first was looked upon with suspicion, but is now thoroughly well-established all over the Continent and in England.

FIRES IN ELECTRICAL "CENTRES."

A SERIOUS fire occurred on Thursday of last week in the building at the southwest corner of Broadway and Eighteenth street. Part of the top floor of this building is occupied by an exchange of the Metropolitan Telephone Company, and several of the morning newspapers informed their readers on the day after the fire that "central" had been burned out, the switchboard entirely destroyed and that about two thousand telephone subscribers were temporarily without service. This piece of news, fortunately, was incorrect. The switchboard was saved from injury either by water or fire, and the damage to the telephone plant amounted to no more than the fusion of one or two underground cables running up the shaft, a damage that was repaired within a few hours after the extinction of the fire.

This remarkable result, taken in connection with the destruction wrought by fire and water on all the lower floors, speaks volumes for the intelligent work of the firemen engaged in putting out the fire. As a rule it is difficult for any outsider to interfere with or offer suggestions to firemen when at work; they naturally feel that they know their own business best and that outside suggestions are more than likely offered from pure fussiness. Such suggestions are consequently apt to be entirely disregarded. In the case of a fire in the vicinity of electrical apparatus the danger of unnecessary damage by water is even greater than the risk of damage by fire. Two minutes' work with the hose would so effectually ruin a telephone switchboard worth hundreds of thousands of dollars that the repairs would practically amount to building a new board. The average firemen cannot be expected to know this or to believe it, except on official authority, and we cannot refrain from heartily praising the conduct of those who fought last Thursday's fire in accepting the explanations of the officials of the telephone company and acting on them with such intelligence and scrupulous care that they entirely succeeded in guarding the exchange plant

from damage of any kind, either by fire or water. If such a plan of action had not been adopted in the early moments of the fight against the fire the exchange floor would inevitably have been flooded, as it was immediately above the worst of the flames.

The aim of our fire forces is to prevent the destruction of property, and now that in all large cities there are so many buildings containing electrical apparatus and machinery of enormous value it is highly necessary that those who have to deal with the extinction of fires should understand the peculiar susceptibility of almost all electrical apparatus to damage by water. As an additional illustration of the necessity of spreading this information through the ranks of the fire departments of all large cities we may cite a recent case in Chicago, which was attended by results the very reverse of those we have chronicled above. A fire broke out among the mains and feeders at one of the large lighting stations. It had not reached serious proportions when the first engine arrived, and although those in charge of the station assured the firemen that it could easily be smothered by other means and that water would do far more harm than the fire, the hose was promptly turned on and a stream directed at the burning insulation. The result, of course, was the instant short-circuiting of the entire plant of several thousand horse-power, to the accompaniment of a display of pyrotechnics that astonished even the firemen. The fire was put out and so were tens of thousands of lamps in the theatres, hotels and stores of the district. A little strategy on the part of the firemen, similar to that exercised by those at the telephone exchange last week, would have averted such a deplorable paralysis of a public service.

We trust that the fire commissioners and fire chiefs in large cities will give their men a few "pointers" as to the peculiar conditions that obtain in fires at electrical centres with a view to averting damage through misdirected efforts. Every electrical man who has the opportunity of talking over these matters with an official of a fire department and making them clear to him will do an indirect but valuable service to his profession.

GENERAL ELECTRIC IN WALL STREET.

How much of the decline in General Electric stock since last October—about 60 per cent., say from 120 to 48—is due to the general depression of securities and how much to special circumstances relating to the business and prospects of that company, no one can say precisely. The fluctuations in the value of the stock during the last few months and the large number of shares bought and sold on the New York Stock Exchange, show that the General Electric Company's stock has become a foot-ball for operators and speculators, and that its price has been for some time a matter depending much upon the preponderance, at the time being, of either the bull or bear interest. Nevertheless, there has been, on the whole, a steady decline in price, till now for several days the quotations have been below 50 for General Electric common shares. This is a very noteworthy situation in view of the recent quarterly dividend at the customary rate of eight per cent. per annum. 16 per cent. is an attractive interest on investments in New York and Boston. It would, therefore, seem that some abiding distrust of the value of the shares must prevail in the minds of investors, some apprehension that the current rate of dividend is likely to be impaired in the near future; or that the company's assets are hopelessly below their nominal amount, however successful its managers may be in keeping up dividends at the old rate for a considerable period. It would seem htat operators and speculators "for the decline" were favored in their efforts by the incompleteness of the annual report of the General Electric Company, as published some two months ago; that is to say, by the inability of investors to form an opinion as to the real earning capacity of the company. Any company, "industrial" or otherwise, must fail to establish confidence in its securities among investors unless it discloses, in its public reports, the actual scope and magnitude of its business, as well as its "net earnings." Successive periods of inflation, accompanied by the booming of new enterprises and of combinations—the latter formed with the promise of reduced general expense and enhanced economy of production and consequent lower prices—have taught wariness to the man with money at command, and he is not at present disposed to part with his cash without a tolerably certain prospect of safety and good interest over an extended future.

But with all abatements, it does not seem reasonable to doubt that the shares of the General Electric Company are worth more than the price prevailing during the latter part of last week. At $50 per share, the capital would be valued at about the sum of the capital obligations of the Edison General and Thomson-Houston Companies when their consolidation was effected, and there is no reason to apprehend that the combined interests will be less profitable than they were separately. But something can never be made from nothing, and we revert to our opinion expressed some weeks ago, that it is fair to regard the value of General Electric stock as ranging somewhere between the lowest and highest quotations of the last two months.

Whatever advantage may accrue to the General Company from the patent decision at Milwaukee last week, we do not believe it possible for it to establish such a control of the electrical industry of the country as it has undoubtedly sought to achieve. The Edison patent if sustained on final appeal, has, apparently, but a year and a few months to run; and so long as iron, copper and other electrical materials, with the requisite brains, knowledge and courage to buy and use them continue abundant it seems to us idle to fear a monopoly of electrical industry by the General company or by any other possible organization.

It seems probable that an appeal will be taken from Judge Seamans' decision against the Oconto Company. As the litigation stands now there are three decisions (one of them that of the Appellate Court in New York) sustaining the Edison patent to one against it (Columbia Co., St. Louis). The force of the decision in the Oconto case, at Milwaukee, may be regarded as somewhat modified by the privilege accorded the defendants to ask for a bond to indemnify them if the patent shall be finally held to be invalid. Suits against other manufacturers of incandescent lamps in the near future seem likely in districts not covered by existing judgments. Meantime the Columbia Company, pending a final hearing of their case, and several other companies not yet attacked, will doubtless continue to manufacture and sell lamps. The fight seems by no means ended.

ELECTRIC RAILWAY DEPARTMENT.

AN AUTOMATIC ELECTRIC RAILWAY TRACK SWITCH.

Horses and mules as motive power for street railways have given place to the far more satisfactory and economical agency

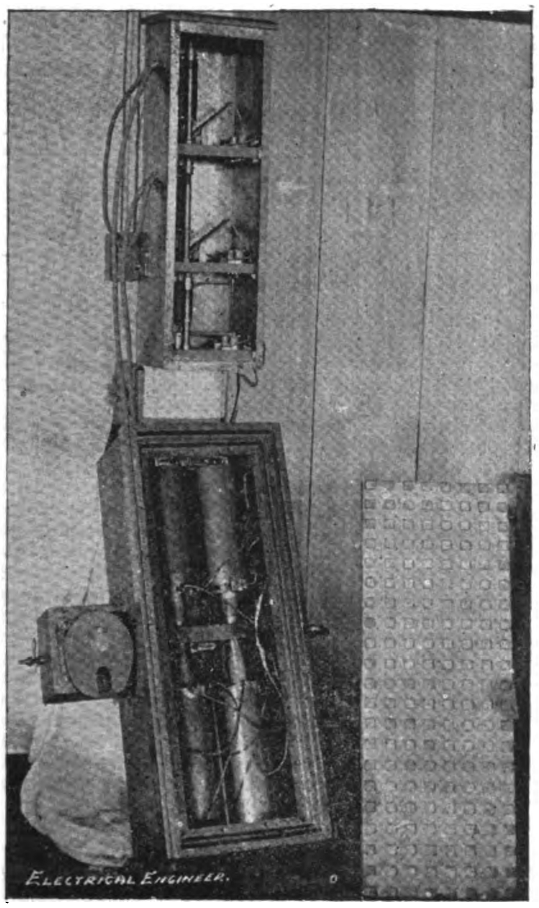


Fig. 1.—Automatic Electric Railway Switch.

of electricity. This change has, however, made useless the automatic platform switches previously almost exclusively used where any automatic switching device was employed. Up to the present time no automatic switch devised for electric surface roads has been found satisfactory in service.

The object of an automatic switch is to lessen delay and econo-

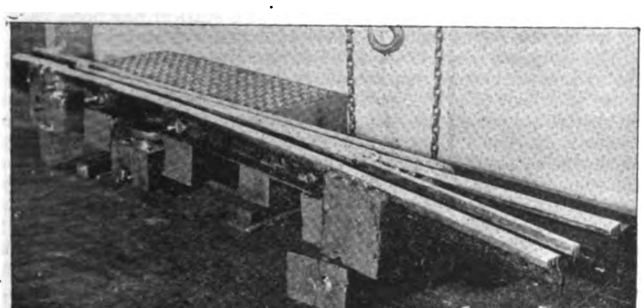


Fig. 2.—Automatic Electric Railway Switch.

mize labor. It does this by making the employment of a switch-tender unnecessary, and by making it possible for the car-driver to control the switch without stopping the car. The requirements of a satisfactory automatic switch are so numerous and peculiar that it is after a long period of experimentation only that the Electric Railway Switch Company have ventured to call public attention to their device.

An automatic switch to be satisfactory must be (1) simple, rapid, and certain in action; (2) must be independent of weather influences; (3) must not obstruct the way or threaten the safety of passers-by; and (4) must not be too expensive.

The Electric Railway Switch Company of Boston, have for

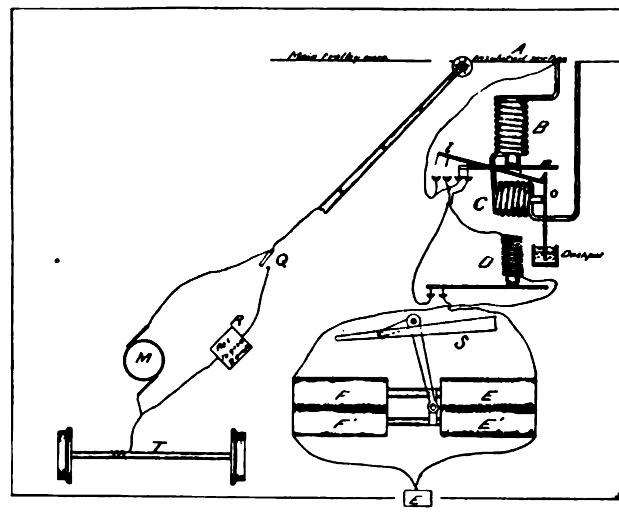


Fig. 3.—Automatic Electric Railway Switch.

some time been at work on and have now perfected a switch which is claimed to embody all the requisites just mentioned. Our engravings, Figs. 1 and 2, show the switchbox and track switch, in perspective.

Fig 3. is a diagrammatic sketch of the connections between car, relays, and switchbox, and Fig. 4 shows a plan and vertical section of the switchbox.

The switch is controlled by the car-driver in the following manner: (1) The normal current taken by the car motor puts the switch

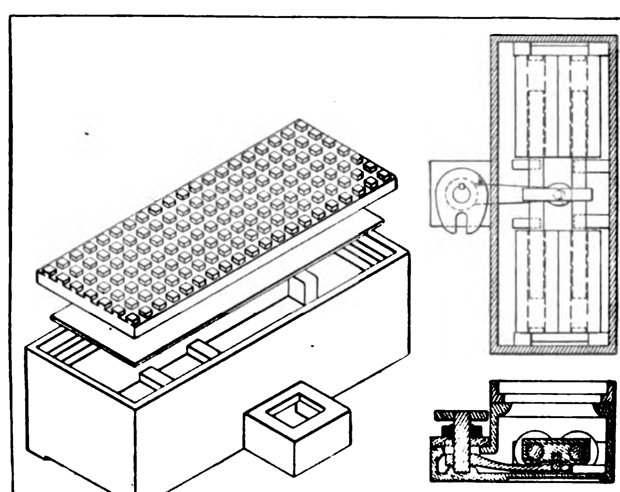


Fig. 4.—Automatic Electric Railway Switch.

to main line at the moment the trolley-wheel reaches the insulated section of the trolley-wire, A, Fig. 3. (2) A slight current drawn through a resistance provided for the purpose puts the switch to branch or shunt while the car is on the insulated section.

The explanation of these two actions is as follows: The insulated section of the trolley-wire is connected with the main line through the heavy relay coils B and C, Fig. 3. Just before a car reaches a switch the trolley-wheel goes on to this insulated sec-

tion; if at the instant it does this the motor is taking a current of, say, eight amperes or over, the armatures l and n are both attracted, closing the circuits through both sets of switch operating solenoids, E, E[1] and F, F[1]; but the magnet D, being in circuit, cuts out the coils E and E[1] and the switch is operated by the coils F and F[1].

If, on the other hand, the car is drawing but a small current, say, two amperes, at the instant the trolley wheel strikes the insulated section, the small catch o is the only armature sufficiently delicate to act. A stronger current then drawn by the motor will have its effect on the armature m only, since the armature l is held down by the catch o, so the circuit through the switch operating coils E and E[1] will be alone closed.

THE TROLLEY KNOCKS OUT THE CABLE IN CLEVELAND.

A SPECIAL dispatch from Cleveland of July 19 says: People here were treated to a rather surprising announcement to-day in the statement that the Cleveland City Railway Company would abandon cable power on its Payne avenue line, about 3¼ miles in length, and equip it with the trolley this fall. This company is a consolidation of the Cleveland Cable Railway Company and the Woodland Avenue and West Side Street Railroad Company. The latter road was equipped early in the Spring with the trolley on all its lines but one, which still retains horses, and when the combination was effected, it was predicted that the cable would be superseded by the trolley.

Cable traction has not been a signal success here and the trolley has.

It is belived that the Superior street cable, which is the other branch of the road, will be replaced as soon as practicable by electricity, but this is not so certain, as it lies between two other lines owned by the same company, both of which will be equipped with electricity by the beginning of Winter. This prevents its coming in competition with the trolley on rival lines, and may keep it going longer. It is clear, however, in this city that the cable cannot compete with the trolley.

"A NOVEL TROLLEY ACCIDENT."

THE above is the extraordinary caption given to the following item of news by the *New York Times*. And yet it is not so very extraordinary, for everything is a trolley accident that the trolley does not have anything to do with:

"While John Deirne, aged seven years, of Thirty-fifth street and Third avenue, Brooklyn, was playing with a trolley feed wire which was being strung on Second avenue yesterday afternoon the team drawing the wire started and Deirne was thrown 10 feet in the air.

"He struck on his head. His skull was fractured and he received an electric shock. He will probably die."

Where the poor trolley comes in, it is easy to see.

CARRYING THE ENTIRE POPULATION OF TROY, N. Y., IN ONE DAY.

OUR Troy, N. Y., correspondent writes us:—The Fourth of July celebration in this city demonstrated to a remarkable degree, the carrying capacity of the electric street car service. Over 70 cars were in constant use all day, carrying at the lowest statement made public over 64,000 passengers, with cars running at one-half minute headway. This would represent the entire population of the city of Troy excluding suburbs. Despite the immense crowds, the excitement and other conditions so conducive to accidents, only *one* of a very slight nature throughout the day was reported. The elastic ability of the electric system to handle the varying demands upon the power station was proved to a degree not equaled in this city at any time heretofore.

THE CORRIVEAU-WILLIAMS SYNDICATE, under the incorporated name of the Montreal Park and Island Railway Company, has entered into an agreement with the Montreal Street Railway Company by which it acquires the right to run its cars over the tracks of the latter company in order to reach the centre of the city. Furthermore, the Montreal Street Railway Company is to confine its operation to the city of Montreal and two or three of the adjoining municipalities from which it has franchises, and on the other hand, the Park and Island Company is to confine its electric railway system to the other towns and municipalities of the Island of Montreal. These number twenty-three and will require a system of over 100 miles of road. Mr. Corriveau states that it is the intention of the company to extend its system over the Back River which forms the northwestern boundary of the Island, to a few of the municipalities there.

MR. L. E. MARPLE, formerly connected with THE ELECTRICAL ENGINEER, has been appointed electrical engineer of the Montreal Park and Island Railway Company, and has arrived in Montreal to begin his work.

LETTERS TO THE EDITOR.

THE RIGHT TERM FOR "RIGHT CURRENT."

THERE has been considerable discussion with regard to the use of the terms "continuous current" and "direct current." Why would it not be well to adopt the term "right current," suggested by analogy of the term "right line"? The term is shorter than either of the others and seems quite as suggestive in its meaning. Let us have the opinion of all those interested.

J. STANFORD BROWN.

NEW YORK CITY, July 14, 1893.

LONG DISTANCE TELEPHONES.—IMPORTANT USE BY THE PENNSYLVANIA RAILROAD.

THE PENNSYLVANIA RAILROAD COMPANY has already made an important addition to its already excellent means of communication between its officials, one that marks a distinct advance, and in which the long distance telephone plays the important part. It is a system of communication between the offices of the leading officials of the company by long distance telephone, which will save much valuable time and will secure the rapid transaction of urgent business. The important points on the Pennsylvania system thus brought into close call of each other, and with Philadelphia, are New York, Jersey City, Wilmington, Baltimore, Washington, Harrisburg, Altoona, Chicago and St. Louis.

The long distance telephone wires in these and other cities on the Pennsylvania system, where important executive offices are stationed, will run into the private offices of the higher officials.

The introduction of this system, which has been under consideration for some time, is largely due to Mr. Charles E. Pugh, third vice-president, who has given much personal attention to the project. Mr. Pugh developed the plans, decided upon the points to be reached, and made the final contracts with the telephone companies. The system is intended for the exclusive use of the high officials in the transaction of the company's business and no one will be allowed to use the telephones except these officers, even though they desire to communicate with an official.

The great advantage of the long distance telephone system is apparent. Its superiority over the telegraph will be found especially in the transaction of important confidential business promptly. The telegraph does not insure the inviolate confidence between officials that the direct word of mouth over the telephone does, because the message invariably passes through the hands of two and sometimes three or four railroad operators. Under such conditions, the questions under consideration could only be settled by a personal meeting between the officials and this necessitated a large amount of traveling. Much valuable time will now be saved.

CENTRAL STATIONS AND GAS-POWER PLANTS.[1]

A MODEL electric light and power station, in which producer gas is employed, has been erected at Carignan, in the Ardennes, by Messrs. Matter & Co., of Rouen. The engine is a 60 h. p. Delamare, Deboutteville & Malandin gas motor, which is fed by producer gas from a Buire-Lencauchez gas plant. The coal used is very poor, and the consumption is less than 1½ lb. per h. p. hour.

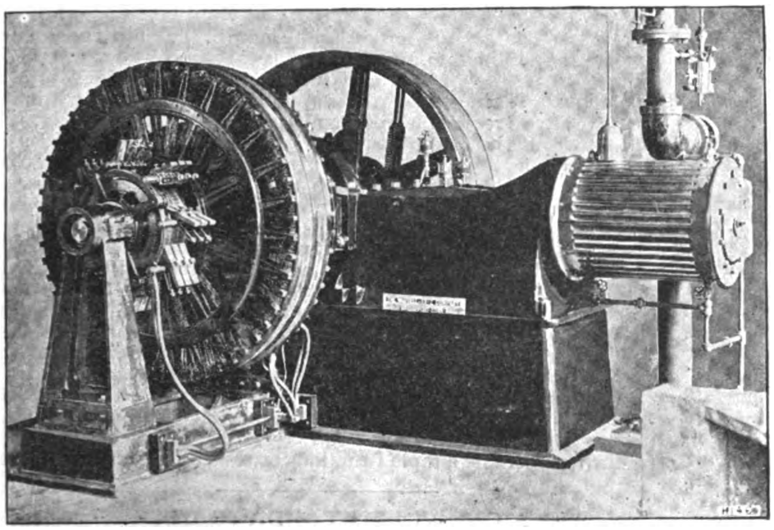
This little station supplies electric energy for power purposes in addition to lighting, so that it is ahead of many of its larger contemporaries in this country. The staff at Carignan consists of one man, who has charge of the gas generator, engine, and the dynamo plant. The electrical part of the station has been carried out under the supervision of Messrs. Orléans & Henrionnet.

The dynamo plant consists of three Gramme machines, of 2, 9, and 24 kilowatt capacity, respectively, and a secondary battery is in use to admit of a large output for short periods. The demand for motive power at present met is 10 h. p. The engine runs from 4 o'clock in the morning till 11 at night, and the accumulator maintains the supply during the time the plant is not running, and ensures a supply at all times. The charges are somewhat high according to what we are accustomed to in this country, but are low enough considering the small size of the plant—only 1s. 2d. per kilowatt hour. Power is charged at 6½d. per kilowatt hour, which is very low. Light and power can also be taken by time valuation, although meters will probably eventually be used. At present Morecambe is the only instance of a central electric-power station run by producer-gas, although there are several private installations using Dowson plant; but the works at Leicester, which the Midland Railway Company are laying down to light their station hotel, and the station at Coatbridge of the Scottish House-to-House Electric Lighting Company, will form examples of heavier work whose results will be closely watched by electrical engineers.

1. *Industries*.

DIRECT-CONNECTED BALL & WOOD ENGINE AND WADDELL-ENTZ DYNAMO.

The advantage of dispensing with pulleys and belts, and making the engine and dynamo one machine, has recently led to considerable development in this direction, and among the leaders in this movement has been The Ball & Wood Co., of New York and Chicago, the well-known engine builders. The high armature speed of the dynamo has long been one of its drawbacks, but in the multipolar type of generator, the electrical engineer has made as notable an advance as that seen in the evolution of the high-speed engine. By presenting a greater number of poles to the armature, the same rate of change in cutting the lines of force is secured with a much lower number of armature revolutions. The dynamo builder has thus wisely come down in rate of speed, while the engine builder has come up, and they have met on ground where they can be extremely useful to each other, and the new combination bids fair to be popular.



Direct-Connected Ball & Wood Engine and Waddell-Entz Dynamo.

The accompanying illustration shows one of three sets of machines which will shortly be placed in the new Metropolitan Club in this city. Two of these will be of 50 k. w. capacity, and one of 30. The dynamos are of the Waddell-Entz pattern with internal multipolar field, and having but a single magnetizing coil. The armatures of the 50 k. w. units are 52 inches in diameter, and that of the 30 k. w. 42 inches.

These machines are compound wound and require no external regulation whatever. The engines of the 50 k. w. generator have 18 x 12 inch cylinders and run at 275 revolutions per minute; while the smaller unit runs at 300 revolutions per minute. The armature is supported at its outer end by an independent bearing which is bolted to a base plate, common to the engine also, and if desired, can be adjustable. Changes are made in the patterns of the engine frame to provide for carrying the fields, and thus a compact and complete whole is formed.

It is interesting to note that the addition of the outboard bearing which supports the armature involves an additional space of only 28 x 20 inches, over that which would be required if the engine were, as usual, provided with two fly-wheels. In other words, the combination here shown of engine and dynamo takes up practically no more space than the engine alone would, where the dynamos are belt driven. In the test made of the combination it was run from Monday morning until Saturday night continuously for 24 hours at full load, with an increase in temperature amounting to only 35 degrees C. above that of the atmosphere.

GERMAN FIRE UNDERWRITERS' ELECTRIC LIGHT RULES.

We have received from Mr. G. Schimmel, manager of the Germania Fire Insurance Company, of Brooklyn, N. Y., a copy of the rules adopted by the German fire underwriters covering all electrical installation. The committee which formulated the rules devoted several years to the study of the question and consulted numerous experts before handing in their final report. The rules embrace only 28 paragraphs, and are modeled very closely after the standard of the American fire underwriters' rules governing similar installations.

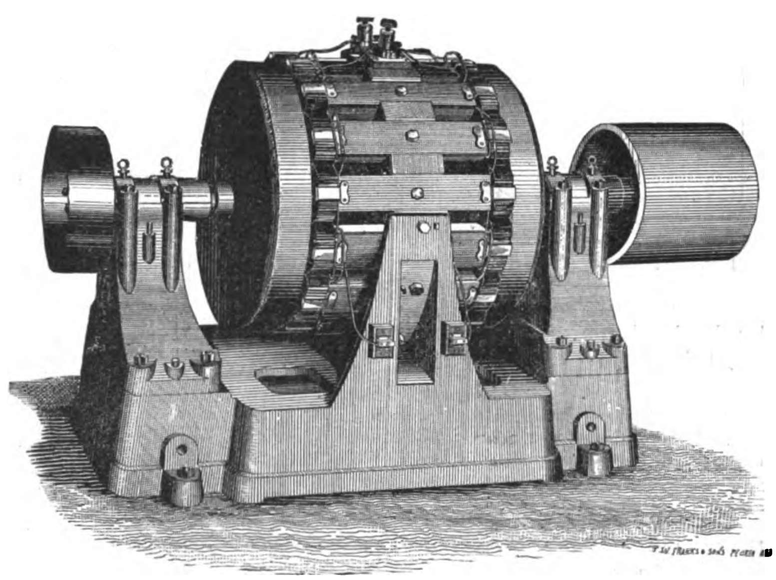
THE AFFAIRS OF THE WENSTROM CO.

The stockholders of the Wenstrom Consolidated Dynamo and Motor Company were recently held to be liable on their stock to the creditors of the company. It appeared from the petition of Jacob H Stadelman, one of the creditors of the company, that the entire stock of the company amounting to $1,000,000, was issued to E. L. Tunis, in payment for certain patents, it being a condition of the subscription, however, that $500,000 of the stock should be transferred to certain trustees to be sold for the benefit of the company. This stock was therefore sold at fifty cents on the dollar to the present stockholders, Mayor Latrobe, Mr. Enoch Pratt, Mr. Robert Rennert, and ex-Governor E. E. Jackson. Judge Dennis, of Baltimore, directs the receivers of the company to collect from the stockholders the remaining fifty cents on the dollar, amounting to $250,000.

THE ROYAL COLUMBIAN ALTERNATING SYSTEM.

The Royal Columbian Electric Company, of Chicago, have just brought out their new apparatus for alternating current distribution. Its most pronounced characteristic is the type of dynamo which the company has adopted and which embodies a number of novel features. The machine has no moving coils whatever, both those of the armature and the field magnet remaining stationary. The accompanying engraving shows its general construction.

The magnetism is generated by a stationary coil surrounding a magnet core to which are attached two disc-like pole pieces. The coils in which the alternating current is generated are mounted at the ends of bars built up of laminated iron and arranged in a circle. The periphery of the disc-like pole pieces revolve in close proximity to these coils; owing to this arrangement no commutators or sliding contacts of any kind are required. The magnetizing coil of the field magnet core, being stationary, is fed from two terminals connected to the exciter, and the alternating current is also taken off from a pair of binding posts. The machine is regulated by a rheostat in connection with the exciter. It will be evident also that by this construction the insulation can be carried to its highest perfection and maintained without the deteriorating influences which are always present in moving insulating parts.



Royal Columbian Alternating Dynamo.

In addition to this machine the company have also brought out a converter inclosed in a weatherproof iron box, and provided with a fuse box which can be so arranged that a burnt-out fuse can be replaced with perfect safety while the current is on the line.

The officers of the Royal Columbian Electric Company, are as follows: president, A. J. Natwick; treasurer, J. I. Stene; secretary, H. R. Fish, Jr. The factory of the company is at Peoria,

Ill., and it has a contract with the Royal Electric Company, of Peoria for the entire output of the latter's factory. Mr. Fish, the secretary, is also president of the Royal Electric and Water Company of Lake Mills, Wis., and his experience in electric lighting will no doubt inure greatly to the benefit of the new concern.

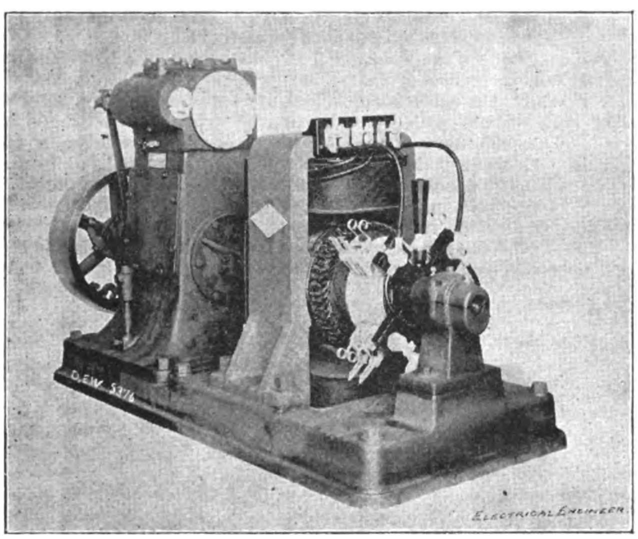
THE NEW DETROIT MULTIPOLAR DIRECT-CONNECTED GENERATOR.

THE steamer "City of Alpena," which has just gone into commission for the Detroit & Cleveland Steam Navigation Company, has been equipped throughout with electric light by the Detroit Electrical Works. The generating plant consists of two multipolar machines direct-connected to Case engines; the combination being illustrated in the accompanying engraving.

The field frame of the machine is of cast steel, and the two vertical magnet limbs alone are provided with energizing coils, the two horizontal poles being formed by induction from the latter.

A special feature of the machine is the armature, which is of the Gramme ring type, but in which the coils are not wound, as usual, so as to completely surround the ring inside and out. They are wound separately on forms, then applied to the outside of the armature ring, being laid in the teeth with which the ring is provided, and each coil spanning about one quarter of the periphery of the ring. With this method of winding, a damaged coil can be removed and replaced in 15 minutes without cutting or injuring any other coil.

This combination has been especially designed for marine and isolated plants of high character. The design is such that the brushes require no lead whatever so that the load can be varied instantly without sparking. Carbon brushes are employed which are placed end on against the commutator. The wear of the



DETROIT ELECTRICAL WORKS DIRECT DRIVEN MULTIPOLAR DYNAMO.

brushes is taken up by springs which maintain constant pressure owing to the ingenious construction of the Detroit brush holder.

The machine illustrated is designed to operate at 550 revolutions per minute, but is so compounded that it can sustain a drop to 500 revolutions per minute, and still maintain its proper potential. Being placed on board ship where the deviation of compasses is to be guarded against, special care has been taken in the design to avoid as much as possible any external magnetic field, and actual tests show that the latter is very small indeed.

The machine has a capacity of 136 amperes, and is designed to run at 110 volts. It occupies a floor space seven feet long and 32 inches wide, and stands 48 inches high.

The following are the weights of the combination: Weight of engine, 1,355; weight of base, 1,030; weight of dynamo, 1,689; total weight, 4,074 pounds.

A MUNICIPAL TELEPHONE SYSTEM FOR GLASGOW, SCOTLAND.

OUR London correspondent writes us:—A special committee recently appointed by the Glasgow corporation to consider the question of Municipal Telephony has unanimously decided to recommend the town council to apply to the Postmaster-General for a telephone license. The committee presents an exhaustive report in which it is stated that estimates furnished by experts show that an efficient system of telephony can be laid down for an average capital expenditure of £15 per subscriber, which would permit of an annual rental of only £5 or possibly less. It is to be hoped that these estimates are not quite so over sanguine as is usually the case with engineering forecasts; at any rate the experiment of Municipal Telephony could not be brought out on more suitable territory than that of Glasgow, where the town council already owns the gas, water, and electric light works and will within a year from the present time have taken over the entire tramway systems of the city.

LONG DISTANCE TELEPHONY.[1]

BY PROF. J. PERRY, F. R. S., AND MR. H. A. BEESTON.

THE case of a line of infinite length, having resistance, capacity, self-induction, and leakage, is taken up, and the state of a signal as it gets further and further away from the origin is considered. Taking the shrillest and gravest notes of the human voice to have frequencies of about 950 and 95 respectively, the distance from the origin at which the ratio of the amplitudes of these high and low frequency currents is lessened by $1/m$th of itself, has been determined when $m = 4$ for different values of leakage and self-induction; and under similar conditions the distances at which the relative phase of the two currents becomes altered by $1/n$th of the periodic time of the most rapid one, have been worked out for $n = 6$. The results are given in the form of tables, from which it appears that, if there was no self-induction, increasing the leakage increases the distance to which we can telephone, whilst, if there was no leakage, increasing the self-induction increases the distance. When self-induction and leakage are not too great, increasing either increases the distance, and for particular values the distances become very large. At the end of the paper, tables of general application are given, from which the limiting distances for any line can be readily found by multiplying the numbers by simple functions of the constants of the line.

A ONE-VOLT STANDARD CELL.

BY HENRY S. CARHART.[2]

THE calomel cell, consisting of mercury in contact with mercurous chloride and zinc in a solution of zinc chloride, was first described by von Helmholtz in 1882.[3] Without any knowledge of its previous invention I made the same cell six years ago and have still the first sample made at that time. Ostwald[4] refers to a calomel cell giving one volt E. M. F. at 15° C., the density of the zinc chloride being 1.409 at 15°, and the temperature coefficient + .00007 volt per degree.

Within the last few months I have taken up the calomel cell again with a view of adjusting it to precisely one volt, making a careful determination of its temperature coefficient, and investigating its reliability.

Taking the Clark cell with excess of crystals of zinc sulphate as the standard, having an E. M. F. of 1.434 volts at 15° C., I have found that the density of the zinc chloride solution required to give one volt is 1.391 at 15° C. Ostwald's density gives too low a value. It was probably adjusted to correspond with the legal ohm.

The cell is made in the same form as my Clark standard. In the bottom of the tube is pure mercury in contact with a platinum wire; on this a paste of mercurous chloride and the zinc chloride solution; a cork diaphragm follows, holding the mercury and paste firmly in position, especially with some asbestos packing under the cork; zinc chloride is then added to the proper depth, and an amalgamated zinc rod, supported by a cork, completes the electrical combination of parts. The cell must be hermetically sealed as usual. Such a cell is perfectly portable and gives promise of long life. Its internal resistance is about 1,500 ohms, and it does not appear to suffer permanent change by heating to 50° C. or even to 60°. The cell six years old already mentioned is still in good condition and has apparently maintained its E. M. F. An interesting feature of this cell is its small positive temperature coefficient. It is well known that the coefficient of the Clark and the Daniell standard is negative. The calomel cell has a coefficient of about + .00009 within working limits of temperature.

NIGHT NAVIGATION ON THE SUEZ CANAL.

NEARLY 91 per cent. of the vessels using the Suez Canal in 1892 pursued their journey uninterruptedly at night by using the electric light, the percentage in the three preceding years being 88.21, 83,56, and 71.74 respectively. The Suez Canal authorities have made it obligatory that, after October 1st next, vessels passing through the canal by night shall employ an apparatus for dividing the light of the projector into two divergent rays. Approaching vessels may, by this means, travel right up to each other without their respective helmsmen being blinded. The diverging apparatus which is to be used has been devised by one of the agents of the company.

1. Abstract of a Paper read before the Physical Society.
2. Read before the National Academy of Sciences, Washington, April 21, 1893. Abstract from the *American Journal* of Science, Vol. xlvi, July, 1893.
3. *Sitzber. der Akad. der Wiss.*, p. 26, Berlin, 1882.
4. *Zeitschrift für Physikalische Chemie*, Vol. i, p. 403.

Legal Notes.

THE FAURE STORAGE BATTERY PATENT DECLARED EXPIRED BY LIMITATION.

On Tuesday, July 18, Judge Coxe, of the United States Circuit Court for the Southern District of New York, handed down a decision in the case of The Electrical Accumulator Company *vs.* The Julien Electric Company *et al.*, in which he holds the United States Patent issued to Faure to have expired owing to the expiration of a Spanish Patent for the same invention. The following is an abstract of Judge Coxe's decision:

Rehearing—In Equity.—The first claim of the patent granted to Camille A. Faure, January 3, 1882, as limited by a disclaimer to an electrode of a secondary battery to which the active layer is applied in the form of a paint, paste or cement, insoluble in the electrolytic liquid, was sustained by this Court March 18, 1889 (38 *Fed. Rep.*, 117). It was again sustained on rehearing (39 *Fed. Rep.*, 490). On the 19th of October, 1891, an order was made permitting the defendants to amend their answer by setting up the grant and expiration of a Spanish Patent issued to Faure, June 27, 1881, for the term of ten years (47 *Fed. Rep.*, 892). Proofs were taken on this new issue, and the cause now comes on for rehearing upon this issue alone.

It is proved beyond question that a Spanish Patent was issued to Camille A. Faure, June 27, 1881, for a term of ten years, and that this patent expired June 27, 1891. If the Spanish Patent was for the same invention as the patent in suit, it is manifest that the latter expired June 27, 1891. This is the only question: Was the Spanish Patent for the same invention?

Section 4887 of the Revised Statutes provides: "But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent; or, if there be more than one at the same time, with the one having the shortest term."

There seems to be no doubt that the application as filed in the Patent Office at Washington was almost an exact counterpart of the Spanish Patent, and that both the patent and the application were translated from one and the same French origin.

Faure's invention was described by him in the same language, and was presented for their approval to the patent officials of three countries differing widely in their methods for the protection of inventors. If he had made any new discoveries between the date of the French Patent and the dates, respectively, of his application in Spain and in the United States, he certainly failed to note the fact in either specification. The proof that he did make such discoveries is very unsatisfactory. This being so, it precludes the idea that Faure had made many kindred inventions along the same lines, which he was desirous of protecting. Like Mr. Brush, for instance (47 *Fed. Rep.*, 48, 51, 54), it clearly was his intention to take out a patent for the same invention in the two countries. This is not disputed. One of the experts for the complainant says. "These patents (Faure's) intended to cover the same invention, differ widely."

Again, there is an express admission that the United States and French Patents are the same, the specification of the former stating that the invention was "Patented in France, October 20, 1880," and in the oath attached to the application Faure swears that the invention has "been patented to him by Letters Patent of the French Government."

There is also an admission, at least, by implication, that the Spanish and French Patents are the same. The Spanish law permitted a patent for 20 years, "if it has for its object new and original inventions," but if the inventor had obtained a patent therefor in one or more foreign countries the term was for ten years only. The French Patent had been granted (October 20, 1880), when the application for the Spanish Patent was filed (April 16, 1881). The inventor asked for a ten years' term in Spain presumably because he knew that he was not entitled to a twenty years' term, the invention having been patented in France. Furthermore, the proceedings instituted on behalf of the complainant to reinstate the Spanish Patent proceeded upon the theory that the French and Spanish Patents were for the same invention. In other words, a concession that the Spanish and French Patents are the same, is also a concession that the Spanish and United States Patents are the same. The latter two cannot both be like the French Patent without being like each other also. The description of what Faure discovered was the same in both cases. If the domestic patent is for another invention, the patent should have been granted to the Patent Office officials and not to Faure; the changes are theirs and not his. Not only are the two descriptions from the same source, but the drawings, except in a few unimportant details, are identical.

If a patent, when granted, covers an invention which has been previously covered by a foreign patent, it expires with the foreign patent, notwithstanding the fact that it has subsequently been pared down to cover only one method of practicing the invention, or restricted to a single claim. A disclaimer cannot add a new invention to the patent. Assume the case of a foreign patent and a United States Patent subsequently granted in language precisely identical. Assume that, pursuant to the decision of the Court or for other reason, the inventor has disclaimed all of the claims but one and that one is so restricted that it covers only one feature not made prominent in the original patent; can it be said that this proceeding wholly changes the scope and purport of the patent, making it, in fact, a patent for a different invention. If so, disclaimers will be put to new and important uses never dreamed of before.

The use of a paste is not, it is true, recommended in the Spanish Patent as the best way of applying the active material, but neither is it in the United States Patent. It is suggested in both, but the language is rather more general in the latter than in the former.

The Spanish Patent certainly suggests the mechanically applied paste coating, and could be limited to such a coating by disclaimer as well as the United States Patent. If the words "galvanic process, chemical precipitation or" were omitted from the first claim of the Spanish Patent, and corresponding words were stricken from the description, the patent would protect the paint, paste or cement method as effectively as the United States Patent.

If the language quoted from the Spanish Patent does not convey to the mind as clear an idea of what Faure actually did as the phrase "in the form of paint, paste or cement," it is only because this expression did not occur to him or the solicitor who prepared the description of the Spanish Patent. The phrase does not occur at all in the specification filed with the application for the United States Patent or in the description and claims as they originally went to the issue division. It seems to have originated with the solicitor who prepared the amended specification as the outcome of a fortunate accident. In the Spanish Patent "paste" is used, "cement" is used, and, if "paint" is omitted, its place is supplied by "plaster," which is an equally appropriate word. Sir William Thomson, in describing the Faure invention, used this word in preference to all others. He said: "The battery consisted of sheets of lead *plastered* over with a paste of moistened red-lead."

One skilled in the art could learn the mechanical application in the form of a paste equally well from both patents. The United States Patent furnishes no information on the subject that is not found in equally clear language in the Spanish Patent. It is true that the first claim of the former is for a product, and of the latter for a process, but the process makes the product, and the product can be made only by the process. It was the use of this process that was made free by the expiration of the Spanish Patent. Where a product is produced by a certain process, and only so, it cannot be said that he who first discovers the process, and by it produces the product, has made two inventions. "The product and the process constitute one discovery." *Mosler* vs. *Mosler*, 127 *U. S.*, 354; *Plummer* vs. *Sargent*, 120 *U. S.*, 442.

An electrode made by the Spanish process would infringe the United States claim; and an electrode made in Spain pursuant to the United States method would infringe the Spanish claim. The same is true if both patents are limited to the paint, paste, cement or plaster method.

I am constrained to think, therefore, that the invention of the United States Patent, even though construed as the complainant insists it should be, is covered by the Spanish Patent.

Few, if any, of the conditions are present here which differentiated the foreign from the domestic patent in *Brush* vs. *this defendant* [*complainant*,], 47 *Fed. Rep.*, 48, 58. On the other hand, many of the reasons are present which induced the Court to hold that "Case I" and "Case J" of Brush were for the same invention (*Brush* vs. *Julien Co.*, 41 *Fed. Rep.*, 679, 683, 685).

The subject matter is essentially the same in the two patents. An electrician, after reading one, would be as able to construct a mechanically-coated Faure electrode as after reading the other.

It is argued that section 4887 is not applicable, for the reason that the United States Patent was applied for before the Spanish Patent was granted. This question is not an open one in this Court. *Gramme Co.* vs. *Arnoux*, 17 *Fed. Rep.*, 838; 21 *Blatchf.*, 450. *Edison* vs. *U. S. Co.*, 35 *Fed. Rep.*, 134.

Whenever the able and interesting argument in support of the complainant's contention is presented to a tribunal which is at liberty to consider it, it will unquestionably receive the attention it deserves.

For the reasons stated in *Brush* vs. *this defendant* [*complainant*], 47 *Fed. Rep.*, 48, 55, this decision has been reached with reluctance. Those reasons do not, it is true, apply with the same force to an invention made abroad by a foreigner as to an invention made by one of our own citizens; but the statute in its practical operation has failed to remedy the supposed evil at which it was aimed, and the duty of overthrowing a valuable patent under its provisions is one that the Court would naturally wish to avoid. But the question, Do the patents cover the same invention? is fairly presented, and its decision cannot be avoided.

After giving the complainant the benefit of every reasonable doubt, the Court is convinced that the question must be answered in the affirmative. The longer the record is studied, the more

settled becomes the conviction that the invention which Faure patented in Spain and in the United States was the invention which he made and patented in France, that, so far as the inventor was concerned, the language was substantially identical and that the changes in phraseology made by the translators and Patent Office officials, of which changes the inventor was ignorant, did not and could not operate to change the invention.

It follows that the defendants are entitled to a decree dissolving the injunction issued April 12, 1889.

THE OCONTO CO. ENJOINED FROM MAKING LAMPS.

On Thursday, July 20, Judge Seamans of the U. S. Circuit Court, sitting at Milwaukee, handed down his decision in the injunction asked for by the Edison Electric Light Company against the Electric Manufacturing Company, of Oconto, Wis. The injunction was granted by Judge Seamans whose opinion we give in full below:

UNITED STATES CIRCUIT COURT, EASTERN DISTRICT OF WISCONSIN.

Edison Electric Light Co., et al.
vs. } IN EQUITY.
Electric Manufacturing Co., et al.

This is a motion for a preliminary injunction. The complaint alleges infringement by defendants, manufacturers of electric lamps, at Oconto, Wis., of the second claim of letters patent No. 223,898, issued to Thomas A. Edison, January 27, 1880, and adjudged valid, after protracted contest, in the Circuit Court for the Southern District of New York, affirmed by the Circuit Court of Appeals of the Second Circuit. The defendants have answered the original answer admitting infringement of said second claim, as construed in said decisions, but by an amended answer (allowed at the hearing), take issue upon such infringement, avowedly upon their proposed new showing as to the prior state of the art, through the alleged Goebel invention, and the narrower construction, which should thereby be placed upon said second claim; and further setting up prior invention by one Henry Goebel, not litigated in the New York case. For and against the motion, voluminous records, affidavits and depositions with sundry exhibits are presented, to which reference will be made.

It is shown that litigation in behalf of this patent has been actively carried on since May, 1885, both directly and collaterally; that after obtaining favorable decisions in other cases, wherein issues under this patent were involved, and defending successfully against the Sawyer & Man patent (40 *Fed. Rep.*, 21), judgment was obtained in July, 1891, in its action in the Southern District of New York, against the United States Electric Lighting Company, sustaining the second claim of this patent, and decreeing injunction (47 *Fed. Rep.*, 454); which was affirmed by the Circuit Court of Appeals for the Second Circuit, in October, 1892 (52 *Fed. Rep.*, 300). The defendant in that case having turned over to the Sawyer-Man Electric Company the business of manufacturing, suit was brought against the latter, and injunction granted, and affirmed by the same Circuit Court of Appeals, in December, 1892; (53 *Fed. Rep.*, 592).

It further appears that injunctions have been granted against other infringers in this circuit and in various other circuits, without serious contest; and that in the District of Massachusetts, in complainants' suit against Beacon Vacuum Pump and Electric Company, the motion for preliminary injunction was vigorously contested, upon the grounds presented here, and in an exhaustive opinion handed down by Colt, *J.*, February 18, 1893, the injunction was ordered (54 *Fed. Rep.*, 678). On the other hand, in a suit by complainant against Columbia Incandescent Lamp Company, in the Eastern District of Missouri, upon similar motion and additional affidavits, an opinion was rendered April 21, 1893, by Hallett, *J.*, refusing the injunction if the defendants should give a bond.

All of the records and affidavits before the courts respectively, in the Beacon case and in the Columbia case, are here, and much additional testimony—that upon the part of defendants taken since such hearing, in rebuttal, under an order of this court, being in the form of depositions and with cross-examination of witnesses. Therefore this court has the benefit of the opinions handed down at those hearings, and the embarrassment as well of deciding here between apparent differences in views as to the measure of proof demanded.

In the opinion in the Beacon case, the rule applicable to this defense against the motion is stated, citing a number of authorities, as follows: "The burden is on the defendant to establish this, and every reasonable doubt must be resolved against him;" also, that "the presumption of novelty is not to be overcome except upon clear and convincing proof." The showing there made is reviewed at length and found insufficent to meet the requirements of the rule.

The opinion in the Columbia case is not yet reported, but in a copy furnished for this hearing, the views which control the decision are stated as follows: "There is not the measure of proof demanded by complainant's counsel, who maintain that the Court should require proof of the fact beyond reasonable doubt. This degree of certainty is not often attained upon testimony in the form of affidavit when the issue is contested, and it is not reasonable to demand such certainty as to the defense. Complainants must show a clear right in support of a preliminary writ, and a defense which puts the case in doubt is sufficient to defeat the application;" and for its conclusion against the injunction, holds: "It is enough to say that there is a fair preponderance of testimony in support of the Goebel claim."

Decisions of the Supreme Court have settled beyond controversy that for the defense of anticipation, and prior use against a patent, the proofs must be "clear, satisfactory and beyond a reasonable doubt." *The Barbed Wire Patent*, 143 U. S., 275, 284; *Cantrell* v. *Wallick*, 117 U. S., 689; *Coffin* v. *Ogden*, 18 Wall, 120. And that has been the constant rule in this circuit: *Smith* v. *Davis*, 34 *Fed. Rep.*, 783; *Washburn & Moen Manufacturing Co.* v. *Haish*, 4 *Fed. Rep.*, 900; 10 *Biss.*, 65; *American Bell Telephone Co.* v. *Cushman Telephone Co.*, 35 *Fed. Rep.*, 739.

The decisions and text books agree upon the general rule stated in the opinion of Judge Colt (*p.* 679) that an adjudication of the validity of his patent after *bona fide* contest, and especially after long and expensive litigation, entitles the complainant to a preliminary injunction, in a suit against other infringers, and that the only question open upon his motion therefor is that of actual infringement by the defendant of the claim so adjudged valid. Other defenses are then reserved to final hearing, and injunction issues, as of course in the same court, and by comity in other courts. One exception to this rule is sometimes allowed, and that is where there is clear showing of a meritorious defense, which was not before the Court in the original suit, and which, had it entered into consideration, would probably have defeated the patent or claim. It is under this exception that the defendants assert their right to oppose this motion, and their affidavits are directed to proving an invention and use by Henry Goebel prior to that of Edison. Although sundry other claims of priority have been set aside by the Court in the course of the litigation, this one was not presented, and the defendants have a right to their day in Court for its hearing. The question here is whether there is such clear showing of merit for this claim now asserted, that the defendants should be relieved from the general rule by denying in their case the usual injunctional order; and the primary inquiry is, What must be the measure of proof demanded? Must it be of the quality and quantity required to defeat the patent at final hearing—"clear, convincing and beyond reasonable doubt"—as held by Judge Colt; or will it suffice, for denial of the motion, that it shows a defense which puts the case in doubt, as held by Judge Hallett. It is clear that the presumptions must be in favor of the patent, and that it cannot be overthrown by a mere doubt. I think the true test for proof upon the motion is that it shall be sufficient to raise a presumption that it would have defeated the patent had it been produced at the trial. This would demand, at least, the full measure required to overcome the presumptive force of the patent, and that every reasonable doubt be dissolved against the defense, here as it would be there, as held by Judge Colt. In the eyes of the law, at this stage, the complainants stand upon their rights with their letters patent confirmed after arduous contest, and entitled to preliminary injunctions against infringers; and the defendants must place themselves entirely within the exception to the rule, if they invoke the privileges of that exception, and would deprive the complainants of the fruits of their hard earned victories. The rule held by Judge Colt will therefore be adopted here, and the following additional authorities are cited as supporting it: *Macbeth* v. *Braddock Glass Company*, 54 *Fed. Rep.*, 173; *Accumulator Company* v. *Consolidated Company*, 58 *Fed. Rep.*, 795; *American Bell Telephone Company* v. *Southern Telephone Company*, 34 *Fed. Rep.*, 795; *Siebert Cylinder Company* v. *Michigan Company*, 34 *Fed. Rep.*, 33; *Ludd* v. *Cameron*, 25 *Fed. Rep.*, 37; *Hussey* v. *Whitley*, 2 *Fish.*, P. C.. 120; *Jones* v. *Merrill*, 80, G., 401; *Potter* v. *Fuller*, 2 *Fish.* P. C., 262.

I have examined with care each of the authorities cited in the opinion of Judge Hallett, and others noted by defendants' counsel, but they do not impress me as supporting the rule held in that opinion, or as opposed to the rule pronounced in the cases above cited. With the adoption of this rule, it is not necessary to review in this opinion the affidavits and exhibits which were before the court in Massachusetts, in the Beacon case, as a careful examination has fully satisfied me with the review and criticisms contained in the opinion of Judge Colt, and the conclusions reached by him at that stage. And of the additional evidence introduced at St. Louis, in the Columbia case, it might be sufficient to hold, in accordance with the view stated in the opinion of Judge Hallett with which I agree, that "there is not the measure of proof demanded" by this rule. Resting upon those conclusions, it would only be necessary to consider the new testimony, which has been presented here, and determine whether it has cleared the doubts which have come from the former hearings; but an understanding of the conclusions reached requires for preface a statement of some of the doubts which have been impressed upon my mind by these records.

Edison's discovery was published late in 1879. It promised an

incandescent electric lamp which would supply the great want of an operative commercial light, suitable for domestic uses, cheap and practical, and aroused great interest and excitement in commercial and scientific circles. Lighting by electricity had long been an accomplished fact, in arc lamps and various single burners, but the problem which had remained unsolved was a method of subdivision of the light, for which scientists in Europe and America were seeking, and which many of them pronounced impossible, an *ignus fatuus*. It was the solution of this problem that Edison thus announced. As stated by Mr. Justice Bradley in the McKeesport case (40 *Fed. Rep.*, pp. 29–31), "This was the real, the grand, discovery in the art of electric lighting, without which it could not have become a practical art for the purposes of general use in houses and cities. . . . We think we are not mistaken in saying that but for this discovery electric lighting would never have become a fact."

The invention claimed by Edison was a lamp which is "the embryo of the best lamps now in commercial use." The second claim of his patent here involved described it as follows: "The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass and from which receiver the air is exhausted, for the purposes set forth."

The thread or filament of carbon for a burner was the fundamental discovery to obtain this subdivision of electric light, for by its use he obtained the high resistance which was essential to the multiple arc system and saved it from the use of enormous conductors of the electric current, the cost of which was otherwise prohibitive of subdivision. He found that for stability of this thin carbon it was necessary to have a high vacuum, and remove all gases to prevent what he calls "air-washing." This led to the entire glass receiver or chamber for the lamp, and finally to platinum leading-in wires, sealed into the glass, because "the coefficient of expansion of glass and platinum was the same," and the high vacuum would be retained, while iron or copper wires would destroy it. The discovery was thefore in successive steps, and only as essentials for the great object of subdivision of light.

Each of these steps is claimed to have been discovered or taken by Henry Goebel many years before Edison. Against all the improbabilities of this claim, the story as related by Goebel, in his several affidavits, with detail confirmations, by many witnesses, is interesting, circumstantial, and in many respects plausible, and I do not wonder that it has attracted such earnest advocacy by able counsel contesting this patent.

Henry Goebel is now 75 years of age, a German, came to this country in 1848, and has ever since resided in the city of New York. He appears to have been an excellent and ingenious mechanic, engaged in watchmaking, manufacturing barometers and thermometers and delicate instruments, and has shown much interest and aptitude in electrical appliances and experiments. He claims to have made incandescent electrical lamps, identical with the Edison claim in all particulars, from about 1854, and that these lamps were operated by primary batteries of his own construction, and used at his store for show and lighting in various ways, and for some time had such lamps on a wagon traveling about the streets of New York, with a telescope, also of his own construction. He says he made many of these lamps each year prior to Edison's patent, and all for his own use or gratification, but not so many after 1872 as before. In 1880, and later, he was engaged in making electric lamps for the American Electric Light Co., a rival of Edison's and making similar lamps. This meagre statement cannot fairly present his story, but must suffice with mention that he was, before leaving Germany, very intimate with a Prof. Munchausen, who had experimented with the production of arc and incandescent electric lights, and gave him the ideas which he carried out here. Goebel does not claim that he ever worked or thought in the line of subdivision of electric lights, and the history of that art presents strong grounds for doubt.

As to the improbabilities of this discovery so long undiscovered, it is sufficient to refer to the comments in the opinions in *Telephone Cases*, 126 *U. S.*, 556, in *American Co.* v. *American Cushman Co.*, 35 *Fed. Rep.*, 735, and *American Co.* v. *People's Co.*, 22 *Fed. Rep.*, 309, as well applicable here. I will refer to some of the doubts raised, upon the defendants' showing, as to the actual components of these alleged Goebel lamps, remarking that the testimony of the numerous witnesses, however honest, speaking of such delicate structures seen by them many years ago, cannot justly be accepted as absolute verity.

1. The fundamental thread-like carbon burner of Edison only became necessary as a means to subdivision of electric light, which was not contemplated by Goebel. The latter operated with a primary battery, for which the larger "pencil" form of carbon or other material would answer as well, would be more stable and more easily made. This filament is most delicate and difficult to make, and must have a high vacuum or it will be instantly consumed. It seems unnecessary and undesirable for his purpose, and no satisfactory reason is given for its adoption by him.

2. The Goebel lamps are not shown to have had the high vacuum required for anticipation. His principal statement must be taken that he exhausted his lamps by the Torricellian method in the years prior to 1879, and I think it is abundantly shown, although not without some contradiction, that such a method could not produce the vacuum necessary to prevent disintegration of the carbon; and it seems doubtful whether it could be employed at all with this delicate carbon in the receiver. If that vacuum was wanting, the claim fails.

3. No motive is shown for such constant manufacture of these lamps throughout the years from 1854 to 1880, involving so much of time and expense, and especially of great expense in maintaining the batteries for their use, and no attempt to dispose of even one, or to utilize them for domestic purposes excepting in a few stray instances. It seems improbable that the constant practice here asserted, and so useful for the purposes of this defense, would have been kept up without clear object.

4. Why did he not apply for a patent? He was not ignorant of the patent laws, for in 1865 he is shown to have applied for a patent on a sewing machine hammer, and in 1881 he is found applying for some minor improvements, one of them being a coil shown in his exhibit lamps.

5. The lamps which Goebel produced at Boston, as original lamps, made in the early years, were four, called exhibits 1, 2, 3 and 4. The first three only were produced at the hearing, with his original affidavit, the fourth being in the hands of counsel for defendant, but withheld because of doubts as to its authenticity—which doubts were afterwards cleared to their satisfaction, and this lamp then introduced by leave of Court, with additional and explanatory proofs. The first three had copper and iron leading-in wires, were of what Goebel calls "meat saw" pattern, and show no vacuum now, and if fully proved would not constitute anticipation of Edison. No. 4 called the "hairpin" pattern, has the requisites, including a vacuum, although probably not the high vacuum. It is not now operative by reason of some defect. Goebel swears that it was operated, but experts who have examined the defect, swear that it has existed from its manufacture, and it could not have operated. This lamp shows the highest excellence of the glass blower's art, is stated by experts to be beyond the ability of any amateur; and many peculiarities are pointed out in the perfect shape of the carbon, the glass bridge and position of leading-in wires, which seem to show adoption of methods which have been produced and developed from the experience of commercial manufacture with Edison's invention. The statement as to its make, its keeping or its having been operated are not clear or convincing to the Court, if they have been made so to counsel. Exhibit lamps Nos. 9 and 11, brought to St. Louis are no more satisfactory than No. 4.

6. After Goebel's employment in lamp making by the American Company his claim of anticipation received some attention, and he had negotiation with one Dreyer, in 1882, for arranging a company to exploit the claims. It failed because he was then, apparently, unable to produce an original lamp. Later it was investigated by eminent patent lawyers, at various times, and apparently with great care and interest to employ it in defenses against this patent, and also by one in behalf of complainant, and all rejected it as not well founded. Prof. Thomson, of the Thomson-Houston Company, investigated it in 1882 when it would have been of vital interest to his company to make use of it against this patent, if tenable, and after visiting Goebel he rejected its consideration. Dr. O. A. Moses, an inventor with similar object, visited Goebel frequently, but came to the same conclusion and says he was unable to produce any lamp. These are potent circumstances to raise doubt.

Coming to the new testimony produced for this hearing and which I have carefully considered, I find that the depositions of defendants are mostly cumulative, or in rebuttal of certain new affidavits produced by the complainant, and not here considered, but I cannot find that they remove any of the doubts above noted. On the other hand, affidavits now produced by complainants tend to show an admission by defendants' witness Henry Goebel, Jr. (a son of the claimant), that he manufactured exhibit lamps Nos. 1, 2 and 3, in 1892, for the purposes of this case. There is no denial of this, but it is claimed that this son is venal, and has deserted the defense to favor the complainant. One Heger, a glass blower, swears that he made for Goebel while working with him, "in the early eighties" lamps similar to No. 4, and he thinks he made this one at that time. As to a planer which was produced by Goebel as made by him at an early day, to cut bamboo for his carbon burners, one Korwan and Heger swear that it was actually made by the former in 1883. This is contradicted as to date by an affidavit produced by defendants.

Upon the whole showing, I am satisfied that the complainants are legally entitled to preliminary injunction, and that it is the duty of the Court to grant it without evasion. As stated by Judge Colt, and often held, a bond by defendant is not the equivalent of the injunction which the law gives for the protection of the inventor in the exclusive privileges promised by his patent.

Injunction will therefore issue, but with leave to defendants to move for requirement of a bond by complainants to indemify the defendants for any damages they may suffer if it shall be finally held that the patent is invalid.

WE are informed that the defendants will immediately require a bond from the complainants, and will appeal.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 4, 1893.

Accumulators:—

Secondary Battery, W. L. Silvey, Lima, O., 500,632. Filed July 9, 1892.
Relates to the construction and support of horizontal plates.

Secondary Electric Battery, C. Theryc and A. Oblasser, Paris, France, 500,978. Filed Dec. 2, 1892.
Claim follows:
The process of making a secondary battery element, by forming an envelope with perforated sides from sheets of celluloid or similar material in a plastic or pliable condition, filling the envelope with active material, and a conductor closing the openings through which the receptacle was filled, and subjecting the entire element to heavy pressure.

Alarms and Signals:—

Signaling System, W. E. Deerow, Boston, Mass., 500,563. Filed Dec. 31, 1892.
Specially adapted to fire alarms.

Dynamos and Motors:—

Brush Holder for Dynamo-Electric Machines, H. G. Reist, Lynn, Mass., 500,614. Filed Jan. 28, 1893.
Especially adapted for carbon brushes.

Electric Motor, J. MacHaffie, Schenectady, N. Y., 500,663. Filed Oct. 8, 1891.
Relates to spherical armature dynamos or motors.

Ring Armature, C. W. Jefferson, Schenectady, N. Y., 500,902. Filed Feb. 13, 1893.
Surrounds the entire core with an armor of mica.

Lamps and Appurtenances:—

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 500,657. Filed April 3, 1893.
A double carbon lamp.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, and E. E. Cary, Boston, Mass., 500,670. Filed April 1, 1893.
Leading-in wires are supported in a disc of some such material as asbestos-board fixed in the neck of the lamp, which is sealed by a fusible cement.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 500,671. Filed April 3, 1893.
Relates to the support of leading-in wires by a fusible cement.

Electric Arc Lamp, W. A. Turbayne, Detroit, Mich., 500,829. Filed Nov 5, 1892.
Employs one wide carbon and one of the ordinary form. The wide carbon is fed longitudinally and laterally.

Electric Incandescent Lamp, H. D. Burnett, Lynn, Mass., and S. E. Doane, Swampscott, Mass., 500,849. Filed Oct. 28, 1892.
The conducting wires supporting the ends of the filament are grooved or indented so as to hold the filament in place by its elasticity.

Measurement:—

Multiphase Meter, T. Duncan, Fort Wayne, Ind., 500,858. Filed Sept 3, 1892.
Claim 1 follows:
In an electric meter or motive device, a plurality of coils in combination with a rotating closed circuit or secondary arranged in inductive relation to said coils and a magnetic diverter determining the angle of the lines of force by the induced coils, to the rotating secondary.

Meter for Alternating, Pulsating, or Intermittent Electric Currents, T. Duncan, Fort Wayne, Ind., 501,000. Filed Oct. 10, 1892.
Employs a revolving secondary, a primary coil or coils traversed by the current to be measured, a magnetic path-diverter, and a base pole for securing and holding the primary in position.

Medical and Surgical:—

Electro-Medical Appliance, S. Hetherington-Carruthers, Sydney, New South Wales, 500,767. Filed Oct. 6, 1892.

Metallurgical:—

Method of and Apparatus for Separating Ores, C. Q. Payne, Stamford, Conn., 500,604. Filed April 19, 1892.
Design and arrangement of electromagnets and pole-pieces for effective distribution of the lines of force.

Magnetic Ore Separator, C. Q. Payne, Stamford, Conn., 500,605. Filed May 22, 1892.
Improvement on the above.

Device for and Method of Adjusting and Equalizing the Magnetic Density in the Pole Pieces of Magnetic Separators, C. Q. Payne, Stamford, Conn., 500,606. Filed May 26, 1892.
Designed to equalize or distribute uniformly the magnetic density across the polar faces.

Metal Working:—

Electric Soldering Iron and Heater, A. Tinnerholm, Schenectady, N. Y., 500,661. Filed July 11, 1892.

Electric Welding Machine, M. M. Suppes, Johnstown, Pa., 500,973. Filed Sept. 10, 1892.
For uniting bars or rails. Relates to the support and operation of contact blocks and swageing blocks.

Metal Working, J. H. Bassler, Myerstown, Pa., 501,098. Filed Dec. 23, 1892.
Claim 1 follows:
A method of uniting metals, which consists in heating the materials to be united, then pouring aluminum or aluminum alloy into the joint of the material, and finally passing an electric current through the materials and through the aluminum or alloy.

Miscellaneous:—

Power Transmission, A. L. Ide, Springfield, Ill., 500,579. Filed July 12, 1892.
Especially adapted to driving dynamos and to cases where compact arrangement is required.

Safety Cut-Out, O. Offrell, Middletown, Conn., 500,601. Filed Dec. 5, 1892.
A fuse-box for branch circuits.

Electric Switch, E. Thomson, Lynn, Mass., 500,629. Filed April 20, 1890.
Designed to eliminate or reduce arcing upon breaking a strong current circuit.
Claim 1 follows:
An electric switch or circuit breaker, having a movable part by which the circuit is opened or closed, and a number of insulated conducting pieces forming a series of breaks on the opening of the circuit which tend to prevent the continuance of an arc thereat.

Method of and Means for Producing Alternating Currents, E. Thomson, Swampscott, Mass., 500,630. Filed July 15, 1892.
Consists in establishing a circuit of high self-induction, effecting a rupture of such circuit between closely approximated terminals, such as metallic balls, and diverting the current into a shunt containing a condenser, by means of which the current would be again established between the terminals.

Rheostat, E. Thomson, Swampscott, Mass., 500,631. Filed Aug. 25, 1892.
Suitable for reducing a portion of the energy of the circuit into heat.
Claim 1 follows:
A rheostat composed of a strip of metal wound into a flat plate, provided with insulating material between the turns, and rigid sides of refractory material.

Lightning Arrester, C. S. Van Nuis, New Brunswick, N. J., 500,736. Filed Aug. 20, 1892.
A fusible wire arrester.

Apparatus for Recording the Flexure of Bridges, E. Parenthou, Paris, France, 500,775. Filed July 8, 1892.
Employs an electromagnetic recording device.

Coin Operated Induction Coil, W. R. Pope, Baltimore, Md., 500,776. Filed April 8, 1893.

Electric Hose Coupling, J. B. Strauss, Cincinnati, O., 500,892. Filed Jan. 31, 1893.

Lightning Arrester, W. A. Turbayne, Detroit, Mich., 500,898. Filed Nov. 6, 1892.

Electric Switch, G. E. Linton, Worcester, Mass., 500,918. Filed April 11, 1893.

Insulating Coupling, L. McCarthy, Boston, Mass., 501,021. Filed March 7, 1892.

Railways and Appliances:—

Railway Signal System, G. L. Thomas, Brooklyn, N. Y., and E. C. Seward, Montclair, N. J., 500,827. Filed March 6, 1893.
Adapted to a block system and designed to lessen the number of signal towers required.

Electric Locomotive, L. W. Case, Highland Park, Conn., 500,851. Filed May 9, 1891.
Eliminates brushes by making driving wheels of the commutators.

Conduit Railway Insulator, G. E. Noyes, Washington Grove, Md., 500,937. Filed Aug. 8, 1892.

Electric Railway System, F. S. Perrin, Lynn, Mass, 500,943. Filed April 2, 1892.
Puts the truck, motors and all machinery in a conduit or conduits underground, the car being supported and carried from uprights projecting through slots in the conduit or conduits.

Overhead Electric Railway, J. C. Henry, Westfield, N. J., 501,009. Filed Sept. 27, 1889.
Buries the main conductor underground; brings branch wires from the main through hollow posts to the span wires, which lead current to the working conductors overhead.

Telephones and Apparatus:—

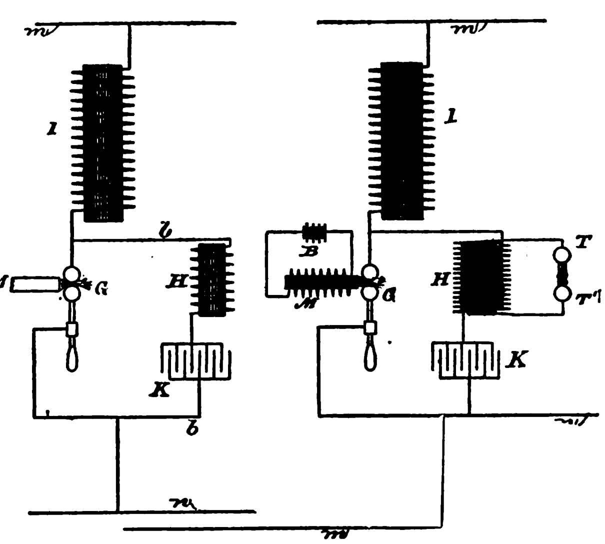
Telephone System, G. L. Anders, London, England, 500,545. Filed Dec. 1, 1892.
Contains a combined transmitter, receiver, ringing key and switching devices. Designed especially for interior purposes, as in hotels, offices and large buildings.

Ear Piece, R. Seiffert, Chicago, Ill., 500,957. Filed Feb. 23, 1893.
For telephone receivers.

PATENT NOTES.

PROF. THOMSON'S ARRANGEMENT FOR OBTAINING HIGH FREQUENCIES FROM CONTINUOUS CURRENTS.

In a patent just issued to him, Prof. Elihu Thomson describes a method for obtaining high frequencies from continuous currents, by which he is enabled to obtain from a 500 volt continuous



FIGS. 1 AND 2.

current, alternating currents having a frequency of 50,000 per second or more. The method consists in employing a branch from a constant potential main and in the branch inserting a discharge with a small spark gap shunted by a condenser. In the shunt in branch around the discharge gap, there is inserted a coil having large self-induction.

The operation of the apparatus will be readily understood from an inspection of Fig. 1, which shows the arrangement diagrammatically.

To operate the apparatus, the balls at G are first made to touch and then separated, and with an adjustment of the gap at G so as to obtain between the balls an apparently continuous discharge. A little care in the adjustment soon determines a condition of

charge and discharge of the condenser K, as follows: The separation at G tends to stop current passing thereat and to divert it to the condenser K, and while this is charging, the arc or spark is extinguished at G as the self-induction I has limited the current from increasing to an amount sufficient to keep up the discharge at G while still charging the condenser K. The charging of the condenser K takes place in a very short space of time and is attended with such an increase of potential from its two sides that, owing to the self-induction tendency or constancy of the feeding current, a spark or discharge again leaps at G, and the condenser at once discharges. The rupture of the spark or arc at G follows immediately, the condenser again charges, accumulates a potential sufficient to leap again, and so on.

It will be seen that that portion of the circuit represented by *b b* will, during the action just described, be subjected to alterations of current as will also that portion of H which represents a self-induction or coiled portion. Unless the capacity of condenser K be relatively very great, these alterations or impulses will be of extreme rapidity.

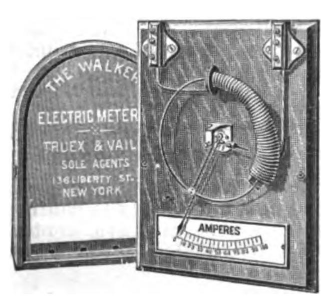
The self-induction at I should be as great as is easily obtained, as its purpose is to practically make the branch *m n* a branch of continuous constant current by resisting sudden changes in the value of the current flowing. It will be evident that the coil H might be wound parallel to another coil and both made to include a fine iron wire core or left without a core, and that the alternations in H would inductively produce corresponding alternations in the coil parallel to it. In Fig. 2 this modification is shown, and the terminals T T' are those of a secondary coil wound in inductive relation to H, and the relation of the turns may be as desired for increasing or decreasing the potential. They are assumed to increase the potential and give rise to a high frequency discharge at high potentials between the terminals T T'.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE WALKER AMMETER.

The accompanying engraving illustrates the Walker solenoid ammeter. Its distinctive features are the small number of parts and their simple character. The action of the ammeter depends upon the attraction of a solenoid for a core consisting of a sector of soft iron wire. These instruments are especially designed for the purpose of remaining in circuit constantly, as they are not liable to change. The peculiar winding of the solenoid, together with the small core and jeweled bearings, allow of practically uniform space readings.



The Walker Ammeter.

They are carefully calibrated, are accurate within one per cent., and are specially applicable for central station and isolated work, and for both arc and incandescent circuits. They are sold by W. A. Vail, 136 Liberty street, New York.

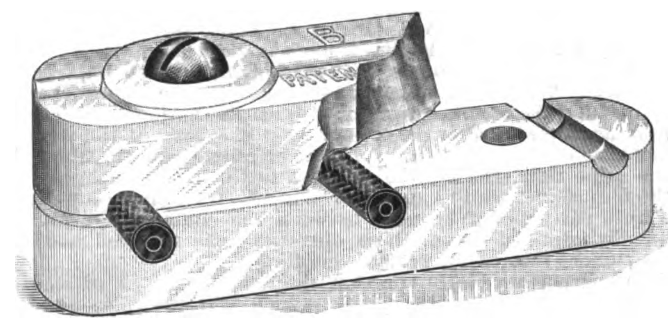
MICANITE PAPER.

The Mica Insulator Co. 218 Water street, are placing on the market a new and useful insulating material called Micanite Paper. This material is unequaled for new work or repairing. It is made in sheets 32 by 32 inches, and the price has been lately reduced to a very low figure. This company are meeting with much success in introducing micanite. They have received some very strong testimonials from the leading electrical manufacturing companies and railroads throughout the United States. They have also established agencies in Europe. Anyone feeling at all skeptical in regard to the insulating quality of micanite, will do well to call at their office, 218 Water street, New York, to see their line of samples, as well as the testimonials referred to above.

The Ansonia Electric Company, report that although the long days are here, the sale of Stanley transformers does not seem to decrease in the slightest.

THE BROWN ELECTRIC CLEAT.

The accompanying engraving illustrates the new Brown electric cleat which is being put on the market by the Brown Electric Company, of Boston. As will be seen, the two halves of this cleat are exactly alike, and that there is no necessity at any time for ordering two kinds to match each other, or having two kinds at hand when engaged on wiring work. The cleat is made for either two or three wires, and is made of the best vitrified porcelain, and is protected by patent. It is extremely simple, and its operation requires no explanation.



Brown Electric Cleat.

THE ELSON & BREWSTER ENGINEERING CO.

This concern is in active business at 123 Liberty street, New York City, where they have hung out a sign as electrical and mechanical engineers and contractors, mechanical draughtsmen, etc. They are sole New York agents for the W. S. Hill Electric Co., and represent also the Pelton Water Motor Co. They have recently equipped the St. Denis Hotel with fan motors, and have other work of the same kind on hand. Mr. Elson is a member of the American Society of Mechanical Engineers, and was formerly superintendent for W. B. Forbes & Co., Hoboken, N. J.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY.

The above company are already very busy at their new headquarters, 249 Second avenue, south, Minneapolis, Minn. They have been in Minneapolis less than 10 days, and have already secured a number of nice orders, among them, the electrical equipment of the department store of S. E. Olson & Co. This plant will be the largest isolated plant in the Northwest, consisting of Standard machines of 180 arc lamps capacity, and of 800 incandescent lamps capacity. The contract includes wiring and installing the machines complete. They have also closed a contract for wiring a store and office building with 430 lights, using Paranite rubber covered wire.

MONTREAL NOTES.

New Westminster, B. C.—The report of the Electric Light Department for the past year, shows that the municipal electric light plant has earned a considerable profit for the city during the last three months of the year. During this period the receipts for lighting were $6,112, including $2,000 for street lights. The expenses for maintenance, etc., were $3,699, and for interest and sinking fund, $1,505, making a total of $5,204. The station which is under the management of Mr. P. Bowler, the city electrician, is conducted as if it were a private institution and a charge is made the various city departments for the lights furnished them. A general lighting business is also carried on and lights are furnished the citizens, but at higher rates than those charged the city departments. These rates are, however, as low as it is possible to make them and are as follows: 2,000 c. p. arc lights burning all night for public lighting, 25 cents a night; commercial lights burning till midnight, 50 cents; current for incandescent lights, by meter, one cent an hour for a 16 c. p. lamp, or by contract, one dollar a month. The station has a capacity of 2,115 incandescent lights and 100 arc lights, current being furnished by Royal arc light dynamos and alternators. To meet the demand for lights, $15,000 has been voted to extend the station and a 1,500 light alternator, with new engine and boiler, has been purchased.

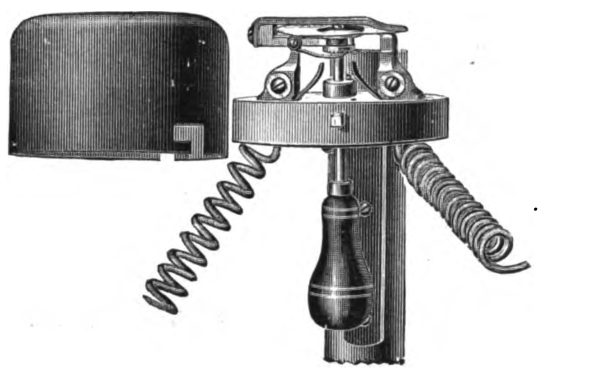
Mr. Lewis Burran has resigned his position with the Royal Electric Company, of Montreal, and accepted that of electrical engineer of the Montmorency Electric Power Company, of Quebec. Mr. Burran, who has been for a long time with the Royal Company, has an extensive practical experience in electrical matters that well qualifies him for the position he is to fill.

NEW MASHINTER FILM CUT-OUT.

THE film cut-out for arc light circuits illustrated in the accompanying cut, is the invention of Wm. P. Mashinter, superintendent and electrician of the Citizens' Light and Power Co., of Montreal, Canada, and is designed to obviate the many troublesome objections of the ordinary film cut-out.

In this device, the film, which is in the form of a disc, is mounted on a carrier and extends between two contacts, of which the upper is a spring pressing upon the lower. These contacts are connected across the loop leading to the lamp, and when there is an open circuit in it, the film is pierced and a short circuit established between the contacts, thus cutting out the loop in the usual manner. After the trouble has been repaired, the cut-out is reset by pushing the handle upwards; this causes the loop to the lamp to be short-circuited at the springs near the base of the cut-out and then causes the upper contact to be raised from the film. At the same time, the spindle attached to the handle engages with the film carrier, and by turning the handle the film is rotated and a fresh portion of it brought between the contacts. When the handle is pulled down, these operations are reversed and the instrument resumes its normal condition.

An important feature is that the film cannot be rotated or moved except when the upper contact is raised. The film can then move freely without touching either contact and it is thus impossible to injure the film, which often happens in resetting ordinary cut-outs. There are many other points about this invention which will be appreciated by those using film cut-outs, by a glance at the cut. The cover need only be removed when it is necessary to insert a new film, which can easily be done in a very few moments.



NEW MASHINTER FILM CUT-OUT.

This cut-out is patented in the United States and Canada, and is being put on the market by Mr. Charles Morton, of Montreal.

NEW YORK NOTES.

E. G. BERNARD CO.—The electric display by the E. G. Bernard Co., Troy, N. Y., on the Fourth of July, was one of the features of the day, although as the commercial circuit was cut off until evening, the plans of the company were somewhat curtailed. Their two large show windows were filled with motor fans, motors and attractive electric appliances, and through the agency of batteries were kept in constant motion. The evening display was even more in accordance with the ability of the concern to keep abreast of the times, as the interior was finely illuminated by colored lights, while the exterior was also noticeable for a long distance, having a magnificent star of red, white and blue electric lights hung at the sign, while some 50 c. p. incandescent lamps over the entrance added to the effect.

THE LUNDELL EXHAUST FAN OUTFIT for ventilating dynamo rooms, etc., can always be installed, the Interior Conduit and Insulation Company informs us, in a manner to obtain the best results, by having an outfit in either end of the dynamo room, one to draw in cool air and the other to drive out the hot, thus keeping a constant change of air. Such an installation should be made so that the hot air is driven out through the street ventilators in the sidewalks. Hot air should not be driven into ventilating shafts. The motors are reversible so that the air can be taken from either side of the building depending upon the direction of the wind, thus insuring perfect ventilation.

"INDUSTRIES AND IRON" is the new title of "Industries," with which *Iron* has now been consolidated. Our excellent English contemporary is already showing the benefit of taking iron into its system. Its offices of publication will be 17 and 18 Henrietta street, Covent Garden, London. Mr. Yeaman is editor.

THE DECLINE IN GENERAL ELECTRIC STOCK.

DURING the past week, in common with other securities, but in a more marked degree, General Electric stock has received punishment of a depressing nature, due to the persistent raids of the bears and to the peculiar absence of "inside" support. The stock reached as low a point as 46, and the total decline was from 63¾ to 49¼, although only a few month s ago quotations rose as high as 119 and long refused to budge below 110. The total number of shares dealt in during the week was no less than 108,000. General Electric bonds fell during the week to 79.

WESTERN NOTES.

GEORGE CUTTER has just issued a neat little pamphlet telling all about the Rookery, in which he has his offices and headquarters, and of which it is understood he is already understudying for the proprietorship. He is doing a large business and has a great knack of keeping the fact prominent.

CALUMET & HECLA.—The Berlin Iron Bridge Company, of East Berlin, Conn., have received from E. D. Leavitt, consulting engineer of the Calumet & Hecla Mining Company, a contract for the iron roof over their new engine house. The building will be 80 feet wide and 200 feet long.

THE ANSONIA ELECTRIC CO., are receiving orders for the "W. W." lightning arresters and Wirt dynamo brushes from New Zealand, England, India and other foreign countries, which would seem to prove conclusively the sterling merits of these goods.

THE ANSONIA ELECTRIC COMPANY, report that the demand for Crocker-Wheeler motors was never as large as within the past month, particularly in the fan motors. They also report a number of sales of motors for the pumping of organs.

ST. LOUIS NOTES.

MR. E. G. BRUCKMAN, of the Electrical Engineering Co., has been awarded the contract for the installation of the electric light work of the new Union Depot at St. Louis, being one of the largest of its kind in the world, 600 by 700 feet. He has also been awarded the contract for 6,000 incandescent lights in the Union Trust Company's fourteen-story building now in the course of construction.

NEW ENGLAND NOTES.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., are building the iron roof on the new purifier house for the Philadelphia Gas Co., at Philadelphia, Pa. The building will be 70 feet wide and 180 feet long, the roof constructed entirely of iron, covered with slate. The new power house for the Worcester Traction Company, will also be designed and built by the same company.

PITTSBURGH NOTES.

MR. CHAS. LUDLOW LIVINGSTON, Fidelity Building, Pittsburgh, announces his readiness and ability to contract for the complete equipment of electric street railways, central stations, isolated plants, etc. Special attention is given to residences, business blocks, and churches.

PERSONAL.

MR. E. A. FITZGERALD, Insurance Inspector, Syracuse, N. Y., has been doing some good work of late raising the standard of electrical work, and his firmness in insisting on reforms deserves high praise. Mr. Fitzgerald is himself a pioneer in the field, and therefore in full sympathy with later work He was at one time associated with the old Fuller Company and put in some of the earliest isolated plants in New York City. In view of the growth of the industry, Mr. Fizgerald's work daily becomes more arduous and the time is near when he will need assistants to help him cover thoroughly so large and important a department.

THE "ELECTRIC CAR HABIT."

IF there is anything in patronage, says the *Boston Transcript*, every electric car in Boston or its suburbs ought to be making big money. They are so liberally patronized that an electric-car habit is forming.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

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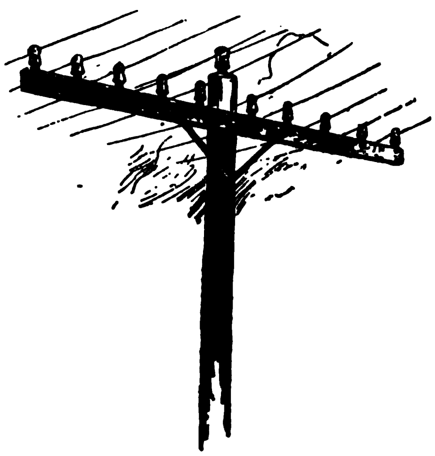
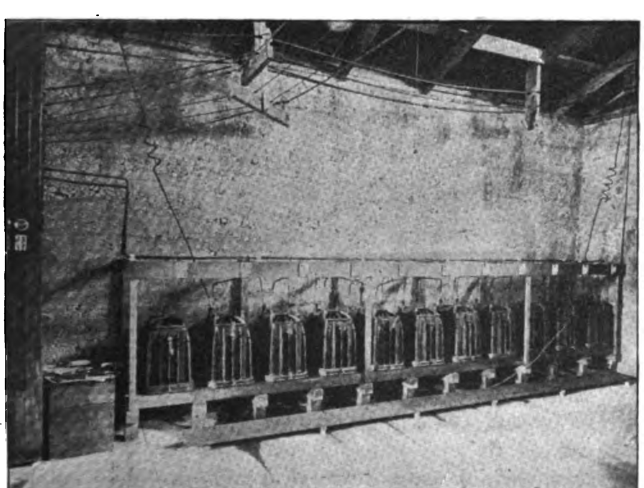
10,000 VOLT ALTERNATING LONG DISTANCE TRANSMISSION AT POMONA, CALIFORNIA.

BY

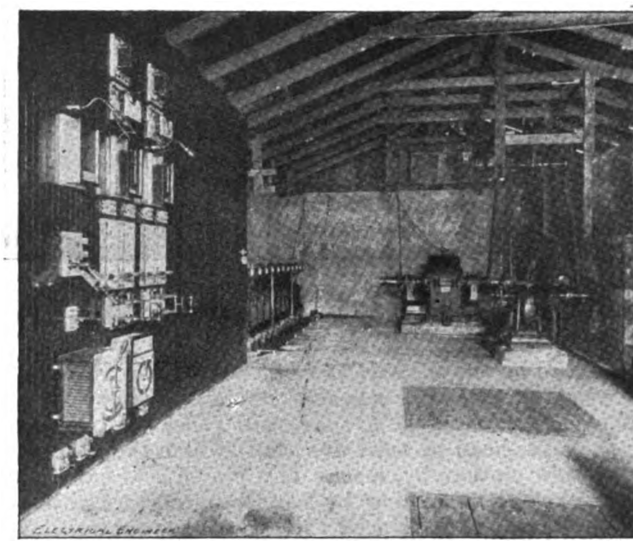
Geo. P. Low.



THERE can be no doubt that the first commercial electric lighting plant operated under a pressure of 10,000 volts and by which a transmission of 28 miles is accomplished, possesses features so interesting as to be worthy of record. Such is the installation of the San Antonio Light and Power Company, of Pomona, California. In the Frankfort-Lauffen experiment both the potential used and the distance traversed in the California plant were materially exceeded, but that was not a commercial installation. In the Deptford station, the normal potential is 5,000 volts with the possibility of using 10,000 volts in emergencies. Clearly then the dual distinction of being the first commencial plant to use 10,000 volts as the normal potential, and of being the longest commercial transmission in the world belongs to the San Antonio Light and Power Company, of California. This is a matter of some gratification to the company, yet more substantial at least is the satisfaction derived from the knowledge that the plant is highly efficient and most successful in every way.



BANK OF 10,000 VOLT TRANSFORMERS.



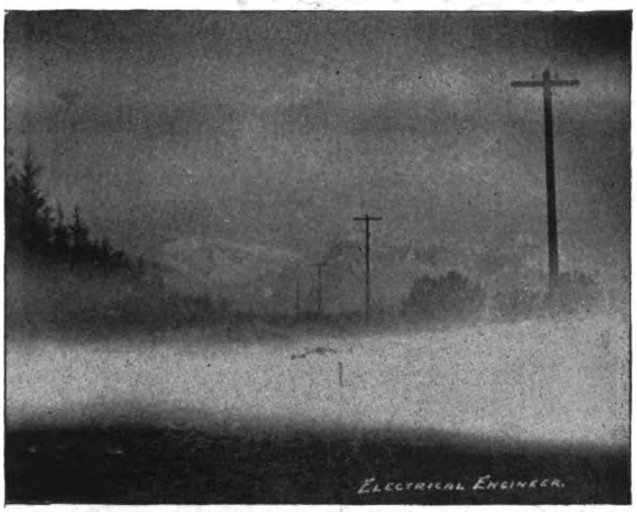
GENERATING STATION, SAN ANTONIO LIGHT AND POWER CO.

The water for operating this interesting installation is taken from the San Antonio River at a point sixteen miles almost due north of Pomona. A picturesque gorge and waterfall together with a very rapid descent in the river affords a great fall in a comparatively short distance so that by building a tunnel 1,324 feet long and by constructing 2,010 feet of pipe line a head of 395 feet is obtained. The 30-inch two-nozzle Pelton water wheel used was one of the first to be equipped with the new differential governor of the Pelton Water Wheel Company, and in a report rendered by Mr. L. E. Imlay, engineer of the San Antonio Company, appears the following record of test of this governor which, considering that the 200 h. p. wheel was working under only about one-quarter of its capacity, appears noteworthy :

Time.	Power.	Exciter Revs.	Generator Revs.
4.30 p. m.	25 K. W.	1,350	600
5.00 "	32 "	1,350	600
8.00 "	28 "	1,350	600
9.00 "	25 "	1,350	600
10.30 "	16 "	1,350	600

A description of the mechanism will be of interest. The Pelton differential governor consists of four miter wheels geared together. Two of them are loose on the same shaft and are driven by pulleys running in opposite directions—the motion of these two wheels being communicated to

the wheels placed between them—turning loosely on a cross-head. One of the pulleys is driven by an independent motor running at a constant speed. The other pulley is connected to the water wheel shaft either direct or by means of a counter. When the water wheel is running at its proper speed, the revolutions of both governor pulleys are the same, although running in opposite directions, and the



Pole Line through San Antonio Canyon—Mountain Fog in Foreground

cross-head on the shaft is at rest. When any variation in the speed of the water wheel occurs, either above or below the normal, the change in speed will cause the two wheels on the cross-head to turn the shaft which then communicates this motion by means of a pinion and quadrant to the rockshaft, operating by connecting levers either deflecting nozzles or balanced valves and thus controlling the flow of water on the wheel. A small water motor is generally used to drive the constant speed pulley, but in the San Antonio plant it is run from the separately driven exciter shaft, the exciter being coupled direct to an independent 13-inch Pelton wheel. The governor is also provided with an adjustable automatic stop which limits its action on the deflecting nozzle or valve, admitting of its being set so that it will throw the governor out of gear at any desired point at either extremity of action to provide against accident.

The necessity for such provision against accident is evident, as it is plain that if the jet strikes the centre of the bucket squarely and the speed is still slow, the governor will still attempt to raise the nozzle, but to do this will not increase the speed as the jet is at the point of maximum effort. The nozzle, therefore, strikes a stop to prevent further raising and should the governor still continue to act, an accident would ensue, an occurrence which is provided against as stated.

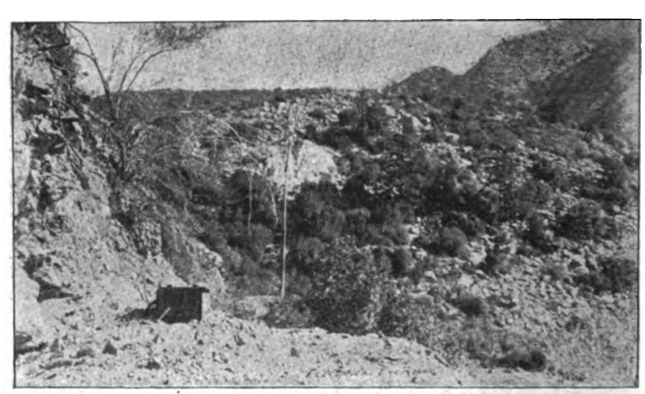
Coupled direct to the large water wheel described, is a standard 120 kilowatt, 12 pole, 1,000 volt Westinghouse alternator which being driven at 600 revolutions delivers current at 7,200 alternations. This 1,000-volt current is taken direct to a switchboard containing the usual Westinghouse central station instruments, whence it is carried to the bank of step-up transformers of the form shown in the accompanying illustration. The whole bank consists of 20 transformers, each having a capacity of six kilowatts and wound so as to take 1,000 volts and deliver 500 volts. The primaries are thrown in parallel across the alternator, and the secondaries are connected up in series, the whole bank of 20 transformers having therefore a potential of 10,000 volts, which is sent to the line. Each transformer is enclosed in oil in an iron case resting upon well grounded iron rails, the cores also being grounded through the case.

From the station are carried two circuits, one to Pomona, 15 miles, and the other to San Bernardino, 28 miles distant. For the first nine miles the circuits occupy the same pole line; then they divide, one continuing southwesterly to Pomona and the other taking an easterly course to San Bernardino. Both these circuits are at present supplied from the bank of transformers described, and are therefore connected in parallel at the station.

The line consists of No. 7 B. & S. hard-drawn bare copper wire supported *on top* of special double petticoat glass insulators designed by the Westinghouse Company for this installation. The diameter of the outer and inner bells of the insulators used are 6 and 3½ inches respectively. Ordinary Klein iron pins are used, and aside from the large insulators and the special method of supporting the wires, the line presents no unusual feature. Santa Cruz redwood poles, 9 x 9 inches at the butt and 6 x 6 inches at the top are generally used, the poles being 25 feet long and set 125 feet apart. The two inside wires are strung 24 inches apart while the two outside wires are separated 18 inches and from the point of divergence the separation is uniformly 24 inches As intimated, the line wires rest in grooves in the tops of the insulators directly over the tops of the pins, thereby obviating all strain to insulators, pins and wires from side connections. No oil insulators are used. In order to avoid trouble that would occur from the settling of dust or its lodgment and adhesion on insulators, all pole lines alongside streets or roads are set to windward of such thoroughfares—for the wind always blows in one direction during the dusty season.

In the substations at Pomona and San Bernardino, the form of transformer used is identical with that found at the station and the method of connecting them up is the same with the exception, of course, that the primaries and secondaries are respectively reversed as is necessary to effect step-down transformation. The number of transformers constituting the banks is, however, reduced to allow for the line drop. A potential of 9,500 volts is delivered at Pomona, the loss under present load being 5 per cent., and accordingly 19 transformers have been placed in the bank, while at San Bernardino, the present loss in transmission is 10 per cent., and 18 transformers absorb the 9,000 volts delivered. The potential maintained on city lines is 1,000 volts and in the substations are found all the usual Westinghouse central station appliances, as well as the Stilwell regulator and compensator.

As might be expected several interesting experiences



Outlet of the Tunnel. Pipe Line in Centre of Picture.

have arisen which are noteworthy, among which may be mentioned the violent induction in the Pomona circuit when the San Bernardino circuit alone is operated; the incessant oscillation of the substation voltmeter needles through a considerable arc, while the lamps remain unaffected; the interesting example of line capacity as shown by cutting out the substation at San Bernardino, connecting the station dynamo to line through the primary of a transformer and burning lamps from

its secondary—the insulation resistance of the line being above the range of an 11-megohm bridge; and lastly, a new phase of the Ferranti effect showing that the spurious Ferranti potential rises with the current.

The inception of the project that resulted in the formation of the San Antonio Light and Power Company is due to Prof. C. G. Baldwin, president of Claremont College, Claremont, Cal., and a member of the Board of Directors of the company. The installation was designed by the electrical engineer for the company, Mr. A. W. Decker, of Sierra Madre, Cal., who early saw the commercial impracticability of the scheme without the use of very high potentials, and to whom must be awarded the credit of having carried out the installation on its present lines. Though supplying current for lighting purposes only, at present, the company is about to engage in power transmission and proposes soon to extend its line in various directions.

A recent test of the system made by the engineers of the company showed the actual efficiency of the electrical system to be 73.3 per cent. Inasmuch as the detailed figures of the test have not been obtained, it may prove of interest to present the following summary of calculations, taken from the original estimates of the company's engineers. All efficiencies are calculated at maximum working capacity at minimum flow of water. It will be noted that the estimates of losses are extremely liberal:

Minimum flow of water per minute	1,260	cub.-feet.
Total fall of water	400	feet.
Less 1¼ per cent. loss in friction, etc.	5	"
Available head	395	feet.

Theoretical h. p. of water:

$$\frac{1{,}260 \times 395 \times 62.3}{33{,}000} = \frac{31{,}006{,}710}{33{,}000} = 936 \text{ H. P.}$$

Less 15 per cent. loss at water wheels	140	"
Delivered to generators	796	"
Less 10 per cent. loss in generators	80	"
Delivered by generators	716	E. H. P.
Less 5 per cent. for exciter and station losses	36	"
Net elec. energy developed	680	"
Less 5 per cent. loss in step-up transformers	34	"
Net elec. output to line	646	"
Less 10 per cent. loss in line transmission (Pomona)	65	"
Net elec. energy delivered to step-down transf.	581	"
Less 5 per cent. loss in step-down transformers	29	"
Net elec. energy delivered to street circuit	552	"
Less 5 per cent. loss on street circuit	28	"
Net elec. energy delivered to consumers' transf.	524	"
Less 5 per cent. loss in consumers' transformers	26	"
Net elec. energy available to consumer	498	"
Total efficiency of water power	83.5	per cent.
" " " electric system	68.0	"
" " " entire "	52.2	"

THE VISIBLE REPRESENTATION OF LINES OF ELECTRIC FORCE.

The following experiment for making visible lines of electric force is described by Herr Bruno Kolbe: Into a flat cylindrical vessel pour purified anhydrous oil of turpentine to a depth of about 2cm., and add some sulphate of quinine. To the rim of the vessel attach two wire springs, adjusted so that the two small metallic balls at their ends dip into the turpentine. Stir the quinine with a glass rod so as to distribute it evenly, and place the vessel on a black cardboard. Join the two wires to the terminals of an influence machine, and turn very slowly. At once the white crystals group themselves so as to form beautiful curves, representing the "lines of electric force." The form of these curves recalls that of the brush discharge of the influence machine. Prof. Weiler, of Esslingen, gives the following experiment: Prepare a milky mixture by stirring up finely-divided quinine in oil of turpentine. On sending a series of discharges through it, a clearance is produced at the positive pole, and the particles cluster round the negative pole, arranging themselves in streamers directed along the lines of force.

NOTES ON THE ELECTRIC ARC WITH SOME EXPERIMENTS ON THE ARC UNDER PRESSURE.

BY DR. LOUIS DUNCAN, A. J. ROWLAND AND R. I. TODD.

Twenty-five years ago Edlund, to account for some of the phenomena which accompany the production of the electric arc, supposed that there existed in it a constant counter-E. M. F. the flow of the current being opposed by this and by the ohmic resistance of the column of heated air and carbon vapor forming the arc.

His formula was:

$$E = a + b\,c\,l.$$

where E is the P. D. at the terminals, a the counter-E. M. F., b a constant, c the current and l the length of the arc.

That this formula is not correct may be seen by an inspection of Table I where the results are approximately represented by

$$E = a + \frac{b\,l}{c^{.7}}.$$

Other formulæ have been used or suggested; for example, S. P. Thompson suggests

$$E = a + \frac{b\,l}{c},$$

and Cross and Shepard employed

$$E = a\,c + b\,c\,l.$$

In each case the formula fits pretty closely the experiments on which it is based, but does not agree with experiments made under different conditions. In fact, almost any

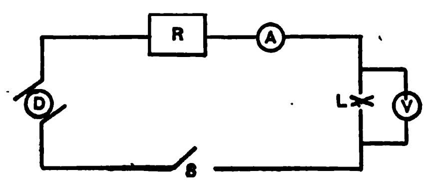


Fig. 1.

results may be obtained by modifying the size and composition of the carbons, and it is of the greatest importance to find what part of the phenomenon is constant and what is variable. The existence of the counter-E. M. F. in the arc —supposing it does exist—has been accounted for in two ways: by the vaporization of the positive carbon, or by the thermo-electric effect of the carbon-vapor couple which exists while the arc is burning. It seems to us that both of these must play a part in the phenomenon. As far as the vaporization of the carbon is concerned, this represents a certain amount of energy taken from the current; therefore there must correspond to it a fall of potential a such that $a\,c$ represents the energy necessary to vaporize the carbon. The amount of carbon vaporized may be calculated from the electro-chemical equivalent of carbon, while the value of a could be calculated if we knew the energy required to vaporize one gramme of carbon. Any attempt to discover a counter-E. M. F. due to this cause by looking for a reverse effect on suddenly stopping the direct current must fail, as the E. M. F. stops simultaneously with the direct current. Such an E. M. F., if it exists, must remain constant as long as the temperature of volatilization of the carbon remains constant. If the temperature is raised—by pressure for instance—this E. M. F. should increase.

As far as the thermo-electric effect is concerned, there is no reasonable doubt of its existence, since we have a composite circuit with two junctions at widely different temperatures. The temperature of the positive carbon is —under fixed conditions of pressure and composition of carbons—independent of the distance apart of the carbons and of the current, but the temperature of the negative carbon depends on both of these. It should be possible to detect this E. M. F. by shutting off the current and looking

for a reverse effect. If we accept the vaporization theory entirely the counter-E. M. F. would be independent of the length of arc and current; if we accept the thermo-electric theory we would look for a much more considerable lowering of the voltage in an alternating as compared with a continuous arc, than really exists. Neither supposition will, by itself, explain the phenomena.

The total P. D. then, should, for given conditions, be represented by

$$E = a + f(l)\, f(c) + b\, f'(l)\, f'(c).$$

Before giving the results of our experiments on the arc under pressure, we wish to call attention to one of the most remarkable of the phenomena exhibited by the arc; a phenomenon which has been often observed, but for which we have seen no rational explanation.

By changing the current of the arc; using cored carbons ⅜ inch in diameter, we obtained the following results.

TABLE I.

1. Atmosphere pressure.

Volts.	Amperes.	Apparent resistance.	Length in inches.
65.	3.1	21.	⅛ inch
58.5	4.6	12.7	" "
55.0	6.14	8.96	" "
54.8	6.15	8.91	" "
52.5	7.7	6.82	" "
52.	8.	6.5	" "
49.2	9.82	5.01	" "
47.5	11.26	4.21	" "
46.5	12.75	3.65	" "

The only explanation admissible is this. The effective E. M. F. is equal to E, the applied E. M. F., minus the constant counter-E. M. F., a, due to the volatilization of the carbons, minus the variable counter-E. M. F., a', due to thermo-electric effects. The arc resistance would vary inversely as the current, provided, as might easily be the case, the section of the arc varied directly as the current.

We have, then, $C = \dfrac{(E - a) - a'}{\dfrac{b\,l}{C}}$, a' being a function of C. If now we increase C we decrease a' and also $\dfrac{b\,l}{C}$, and E will decrease until the equation holds again. For instance, suppose $a = 30$, $a' = 15$, $C = 10$, $b\,l = 5$.

Then, $10 = \dfrac{E - 30 - 15}{\dfrac{5}{10}}$ and $E = 15$. Now suppose we increase C to 20 and a' changes to 10; then

$$20 = \frac{E - 30 - 10}{\dfrac{5}{20}} \text{ and } E = 45.$$

It is evident that whether E increases or decreases depends, first, upon the decrease of a' with the increase of current, and, second, upon the variation of the arc resistance with the current. Both of these will depend on the size and composition of the carbons and their distance apart. So it is very easy to see why different observers have obtained different results and deduced entirely different formulæ.

With solid Carré carbons ½ inch in diameter the results were different, the P. D. remaining approximately constant under the wide variations of current.

ARC UNDER PRESSURE.

The apparatus used consisted of an iron cylinder having stuffing boxes in the ends through which the rods holding the carbons passed. The upper rod had a rack and pinion for adjusting the arc and a scale for measuring its length. There was a pressure gauge on top. An air pump, connected with the cylinder, was run by an engine. There were two windows in the cylinder at right angles to one another, so the carbon could be observed. A water jacket around the cylinder kept it cool. A shunt dynamo which we had somewhat overcompounded supplied the current, which in most of the experiments, was kept constant at 6 amperes. The arrangement is shown in Fig. 1.

TABLE II.

Table of average volts—constant current of 6 amperes.

Length of arc in inches.	Partial[1] vacuum.	Atmospheric Pressure. 1	2	4	6	8	10
1/16	[2]34.19	44.88	47.75	48.5	55.07	56.2	59.0
⅛	54.47	53.48	59.28	62.55	66.82	65.87	60.9
3/16	62.76	60.75	66.33	71.4	76.28	77.75	79.5
¼	71.81	66.78	73.31	79.9	....	....	....

1. About 1 inch of mercury. 2. Probably hissing arc.

TABLE III.

Pressure in Atmospheres.	Constant a. 1/16 and ⅛" lengths.	1/16 and 3/16" lengths.	1/16 and ¼" lengths.
Vacuum	18.91	19.90	21.65
1	36.28	36.94	37.58
2	35.94	38.48	39.48
4	34.5	36.2	38.0
6	43.32	44.49	....
8	46.53	45.4	....
10	48.1	48.5	....

TABLE IV.

Pressure in Atmospheres.	Constant a. 1/16 and ⅛" lengths.	⅛ and 3/16" lengths.	3/16 and ¼" lengths.
Vacuum	18.91	37.89	35.61
1	36.28	38.94	42.66
2	35.94	45.18	45.36
4	34.5	44.85	45.90
6	43.32	48.	...
8	46.53	42.11	....
10	48.1	50.7	....

In determining zero readings on the scale, a high resistance, made of graphite, was thrown in series with R. This was so proportioned that when the carbons were apart, the reading on the voltmeter was about one-third that of the dynamo. When the carbons touched, the voltmeter fell to zero. Each reading was repeated a number of times. No readings could be obtained while the air in the cylinder was being disturbed. The results are given by the curves Figs. 2 and 3 and tables.

As c remained constant during the experiments, the value of a, considered as a constant, may be calculated from

$$E = a + b\, l\, f'(c).$$

No matter what the function f' may be. Doing this we find the values of a given in tables III and IV.

Leaving out values for the vacuum, which are low, be-

cause of the very low reading taken for $\frac{1}{16}$ inch, we see that by combining the values for $\frac{1}{16}$ inch with the $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ inch we get increasing values of a as the length increases, while if we take $\frac{1}{16}$ and $\frac{1}{8}$ inch then $\frac{1}{8}$ and $\frac{3}{16}$ inch and $\frac{3}{16}$ and $\frac{1}{4}$ inch, the increase is more rapid.

The tables show that a varies with l for all the pressures employed, for no function of l substituted for l in the formula will make a constant in the two tables. The absolute values of a, given in the tables, are, probably not very accurate, as a small error in the voltages is considerably exaggerated in the results, especially in table IV. So, in table I, it is impossible to get any formula to fit the results. If we try to use

$$E = a + b\, l\, f(c),$$

a seems to decrease somewhat as c increases, and the formula

$$E = a + \frac{b\,l}{c^{.7}}$$

is only approximately correct. The increase of E with the increased pressure is shown in Figs. 2 and 3.

The behavior of the arc in partial vacuum is curious. The constant counter-E. M. F. is probably lower and the positive carbon is not so hot, but the negative carbon seems to cool proportionately faster than the positive—so the variable E. M. F. increases.

TABLE V.

Length of Arc, Inches.	Atmospheres.	
	1	4
$\frac{1}{16}$	43.06	48.87
$\frac{1}{8}$	51.22	58.8
$\frac{3}{16}$	57.95	67.5
$\frac{1}{4}$	65.64	.....

Looking at tables II and III we see that the fall of potential due to ohmic resistance does not seem to increase in any regular way with the pressure.

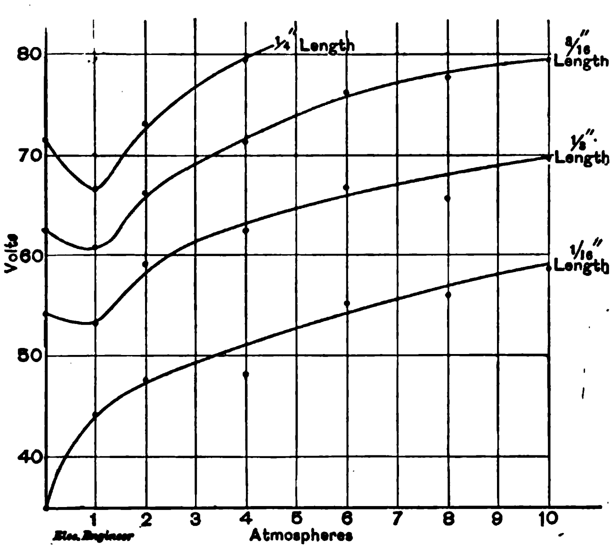


FIG. 3.

TABLE VI.

Atmosphere.	Values of a'.					
	$\frac{1}{16}$ and $\frac{1}{8}''$ lengths.	$\frac{1}{16}$ and $\frac{3}{16}''$ lengths.	$\frac{1}{16}$ and $\frac{1}{4}''$ lengths.	$\frac{1}{16}$ and $\frac{1}{8}''$ lengths.	$\frac{1}{8}$ and $\frac{3}{16}''$ lengths.	$\frac{3}{16}$ and $\frac{1}{4}''$ lengths.
1	34.94	35.64	35.56	34.94	37.76	34.88
4	39.44	39.55	—	39.44	39.9	....

The very small values of a, however, shown in Table III, are due to the low reading at $\frac{1}{16}$ inch where there was, in all probability, a hissing arc. If we take the values from readings at $\frac{1}{8}$ and $\frac{3}{16}$ and $\frac{1}{4}$ inch we find them closer to the values for the other pressures.

To determine the effect of the surrounding gas, some experiments were tried in an atmosphere of carbon dioxide. The results are shown in Tables V and VI. Although the

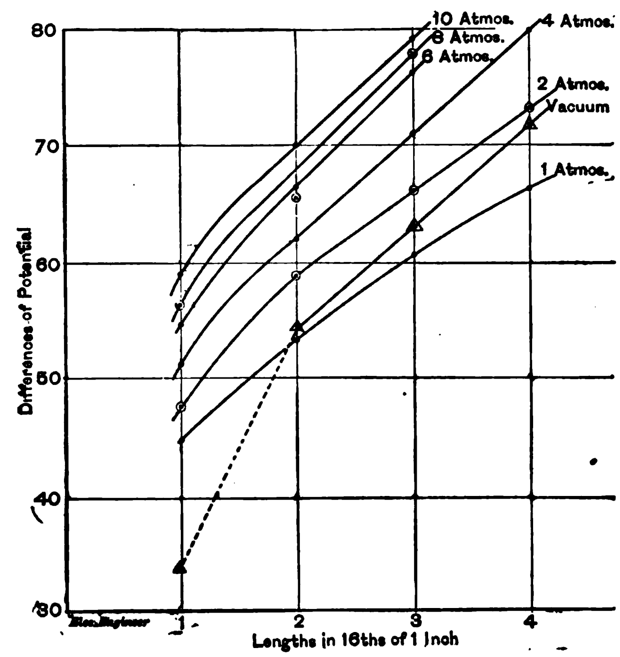


FIG. 2.

values are a trifle lower than for air, they, in general, confirm the experiments of S. P. Thompson, who found that the arc was independent of the nature of the surrounding gas.

We conclude then :

1. That the counter-E. M. F. of the arc is made up of two parts : (a) an E. M. F. due to the volatilization of the carbon, independent of the length of the arc, of the current and of the size of the carbons, but dependent on the pressure ; and (b) a variable thermo-electric E. M. F. depending on the length of the arc, the current, the size of the carbons and the pressure.

2. As the tendency of the arc is to increase in cross-section with the current, its resistance will decrease with the current.

3. The apparently anomalous decrease in E. M. F. with increase of current is probably due to the decrease of the thermo-electric counter-E. M. F. caused by the heating of the negative carbon, together with the decrease of ohmic resistance referred to above.

4. There is a constant increase of P. D. with pressure above atmosphere for a given current and length of arc. Below one atmosphere the P. D. again increases.

5. The counter-E. M. F. apparently increases with pressures above one atmosphere, while the ohmic resistance does not greatly change.

A SOUTH ATLANTIC CABLE.

A CABLE is projected to be laid from Lisbon to the Azores. A British company will lay and own it, and, if the proposals favorably reported by a special committee are accepted by the Cortes, it will have exclusive power to connect the Azores with North America and Cuba, and with England or other points in Europe. Such connections would form a highly important new route between America and Europe. All existing cables to Europe are under the far north Atlantic.

A STUDY OF THE SOURCES OF ELECTRICAL ENERGY.—III.

BY

Francis B. Crocker

(*Concluded*).

It should be observed that neither thermo-electric nor thermo-magnetic generators are strictly cases of the "direct conversion" of fuel energy into electricity. In both of them the energy is first converted into heat which introduces a certain indirectness and, what is more objectionable, brings the apparatus under the second law of thermodynamics and thereby tends to make the efficiency very low, which is characteristic of all apparatus for converting heat energy into any other form of energy.

Numerous attempts have been made to accomplish the strictly direct conversion of fuel energy into electricity, but none of them can be said to be at all practicable. Jablochkoff in 1877 patented a voltaic battery in which carbon was used as the positive plate, the exciting fluid being fused nitrate of potash. This battery is similar in principle to an ordinary Daniell battery, but the electric current is actually produced directly from the chemical energy of fuel, and the theoretical efficiency might be nearly 100 per cent; but unfortunately the active fluid or depolarizer in this battery is very expensive. Attempts have therefore been made by other inventors and experimenters to use some fused compound which could be reoxydized by the passage through it of the oxygen of the air. For example, fused sodium manganate will act in that way, but it has practical difficulties. The ideal cell of this kind might be a large metallic vessel forming the negative plate. This would be surrounded with asbestos or other material to conserve the heat. It could be coated inside with silver or nickel to prevent action by the alkalies, etc., which might be present. This vessel should be filled with a fused compound capable of being reoxydized by the oxygen of the air which would be forced through it. The fuel could be put into this vessel in the same way that coal is shoveled under a boiler, and would be kept in place and out of contact with the sides of the vessel by partitions of earthenware. The fuel would float on the surface of the fused compound and connection would be made to it by means of bars of iron. Such a cell is by no means merely imaginary; it could actually be built and operated successfully. The practical trouble would be that the E. M. F. would be very low, only about one volt, and the internal resistance would not be low enough to allow a large output of current with this low E. M. F. It would therefore take a large apparatus to generate even one horse-power. The low voltage would require a large number of cells to be used for most practical purposes or else transformation by means of a dynamotor. There would be a tendency to an accumulation of impurities in the cell brought there by the fuel, which would necessitate the renewal of the fused compound and involve considerable expense. Other forms of voltaic battery might be employed for direct conversion, such, for example, as a gas battery consisting of two plates of carbon, one of which is supplied with hydrogen or carbonic oxide produced by gasefying the fuel and the other supplied with the oxygen of the air. Batteries of this sort have been tried, but it is difficult to get the gases supplied to the surfaces of the plates under the liquid where it is necessary that the action should take place.

The ordinary primary battery is a fairly good case of direct conversion. Commercial zinc is produced by the chemical action of fuel (carbon) upon oxide of zinc. This zinc can be used in a cell where it combines, usually with sulphuric acid, to form sulphate of zinc. The energy of the combination is given out in the form of electric current. The writer has elsewhere discussed primary batteries in detail and given various data of E. M. F., cost, etc., of different combinations.[1] These figures are not encouraging, even theoretically, and it is of course a well-known fact that primary batteries are not at all satisfactory when any considerable amount of current is required. The principal objections to primary batteries are high cost, large space occupied, and great trouble in maintenance. In the paper cited it is shown that in the cheapest battery, the Bunsen, the cost of the theoretical amount of material required would be 20 cents per horse power hour, to which must be added a considerable amount for waste material and for labor in taking care of the battery, making a total cost of at least 30 cents per horse power hour. This is over ten times as much as the cost of electric power generated by means of the engine and dynamo and makes the primary battery entirely out of the question where anything more than a small fraction of a horse power is needed. The zinc alone in a primary battery costs about 10 cents per horse-power hour, hence it would not help matters much if some depolarizer were discovered which costs nothing. This shows the absurdity of the commonly advertised claims of a cheap depolarizer with which a primary battery can supply "a large number of electric lights at a merely nominal cost."

The other common claim of a battery in which very little zinc is consumed is equally preposterous, since it is a well-known fact that at least 1.17 grammes of zinc must be consumed per ampere hour. Hence we can calculate that if the E. M. F. were two volts it would require almost exactly one lb. of zinc per horse power hour. This voltage is about as high as can be obtained in primary batteries, but even if twice this voltage could be obtained, which is practically impossible, it would still require ½ lb. of zinc per horse power hour. The advantage of all these voltaic or chemical generators of electricity is that they are not limited by the second law of thermo-dynamics. They can therefore, have a theoretical efficiency of nearly 100 per cent., and sometimes actually have a practical efficiency of over 90 per cent. In this respect they are theoretically much more encouraging than the apparatus in which heat energy is converted into mechanical or electrical energy, but practically they are far inferior at present.

In conclusion, it can be said that a study of the possibilities of generating electricity very directly and cheaply is not particularly encouraging and it would not seem that there is any great hope of a radical improvement in this direction in the near future. It looks as if we should have to content ourselves with the gradual but steady improvement of the means which we already have. It is possible, however, that some entirely new principle may be discovered by which electricity may be produced, but it cannot be said that there is any immediate prospect or indication of such a discovery. The thousands of investigators working in well-equipped laboratories, both collegiate and commercial, make the chance of a radical discovery less and less as time goes on. It would be very foolish, however. for anyone to say that such discoveries are impossible or even very unlikely. Certain facts may be cited which would indicate not only the possibility, but the probability of the existence of important undiscovered principles. It was pointed out about a century ago by that great American, Count Rumford, who, like Franklin, possessed a knowledge of these very subjects far ahead of his time, that the efficiency of an animal is greater than that of a steam engine, that is to say, that a certain amount of hay fed to a horse would enable him to perform more actual mechanical work than could be obtained from the same amount of hay burned under the boiler of a steam engine. This simply means that the energy contained in food is converted into mechanical work by the natural processes acting in the organs and muscles of an animal with a higher efficiency than the methods now used by man in the artificial production of power.

1. Possibilities and Limitations of Chemical Generators of Electricity. *Trans.*, Am. Inst. Elec. Eng., May, 1888, The Electrical Engineer, June, 1888.

This is analagous to the fact that the glow worm produces light with very much higher efficiency than any artificial method. Prof. Langley has shown that an ordinary gas burner emits 400 times as much heat as a glow worm when they both give exactly the same amount of light. In other words, nearly all of the energy given out by a gas burner is invisible heat which contributes nothing to the lighting effect, whereas in the case of the glow worm a large part of the energy given out is in the luminous part of the spectrum. These facts concerning the very much higher efficiency of animals in the production of either mechanical work or light might encourage us to hope that these very processes, or similar ones, may be discovered and used artificially. The production by ordinary chemical processes of organic substances such as quinine, alizarine and many others, which was formerly thought impossible, shows that the processes of nature can be imitated by man in the arts. As a further encouragement it should be pointed out that we already have other means besides the dynamo for producing electricity with a very high theoretical efficiency. The ordinary frictional electrical machine produces static electricity directly from mechanical work and while the actual efficiency of such a machine is extremely low, being a very small fraction of one per cent., and while it is probably a fact that a certain amount of friction is required to produce a certain amount of electricity, nevertheless there is no reason whatever for thinking that it is impossible to raise the efficiency of such a machine to 10, 20 or even 50 per cent. When we consider the induction or "influence" machine, whether it be a simple electrophorus or the Holtz machine, the case is still better, because there is no *necessary* friction except that involved in the mere motion of parts, which is true of any machine. Take, for example, the electrophorus; after the resinous plate has been once electrified, charges can be produced almost indefinitely in the metal plate by merely moving it alternately toward and away from the electrified plate, and the only work required to be expended is that due to the fact that the attraction is greater when the metal plate is moved away than when it is moved toward the resinous plate, and if the motion took place horizontally on friction wheels, or by a swinging action like that of a pendulum, the loss from friction could be made very small. But such a machine, although a possible rival of the dynamo is not likely to be practical on account of the very small output or amount of electrical energy generated, compared with the size of the machine. Moreover, what is needed is not a substitute for the dynamo but a direct method of getting current from fuel without heat as an intermediate step.

It would thus appear that the only hope of the cheaper generation of electricity lies in two directions, one being the gradual improvement of the present processes, which will probably continue to go on slowly but surely. The other hope is the discovery of some radically new process by which electricity can be gotten directly from fuel energy. But this hope is very indefinite at present and may be realized in one year or perhaps not for a hundred or even a thousand years. The work of Tesla and others with high frequency alternating currents and electrical discharges gives hope of the more efficient production of light from electricity, but even in that case it would still be necessary to generate electricity by practically the same means as at present.

WORLD'S FAIR DEPARTMENT.

THE ALLGEMEINE ELEKTRICITÆTS-GESELLSCHAFT AT THE FAIR.

Few exhibits in the department of electricity are so interesting as that of the Allgemeine Electricitäts-Gesellschaft, of Berlin. The space occupied is a large one facing on three aisles in the German Section, and the apparatus shown, including everything essential for the generation, transmission, distribution and utilization of current for light and power, aside from its intrinsic worth, affords a splendid opportunity for comparison with that manufactured and used here.

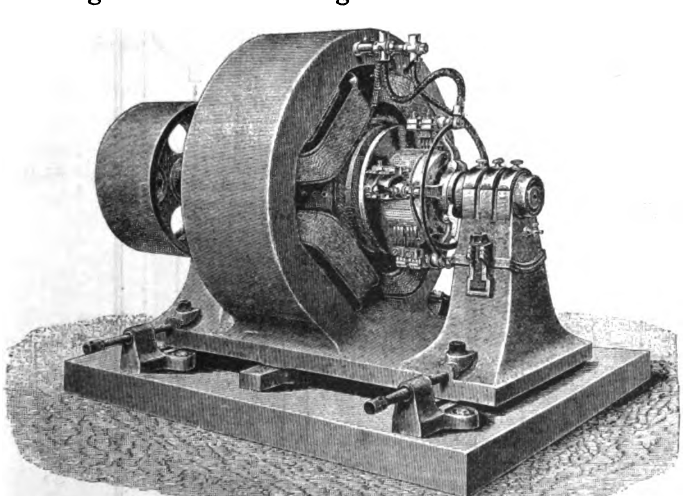


Fig. 1.—4-Pole Motor.

For the operation of the moving part of the display current is brought from Machinery Hall to a four-pole shunt motor shown in Fig. 1, wound for 450 volts and 200 amperes and running at 540 revolutions. Fig. 2 shows the motor diagrammatically, arranged for running both forward and backward. The armature is wound with a single layer of rectangular wire so that each individual wire is very near the pole pieces and the efficiency of the motor is said to be 90 per cent.

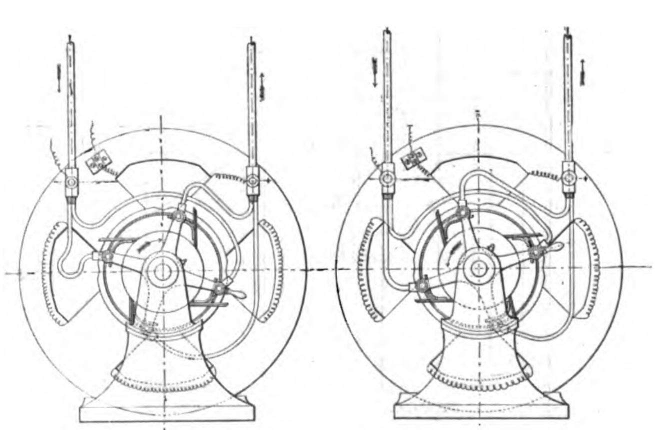


Fig. 2.—Arrangement for Reversing Motor.

From the motor is belted a 100 h. p. three-phase dynamo

of 50 periods having 14 poles and wound for 120 volts between each two wires; its field is excited by a 110 volt

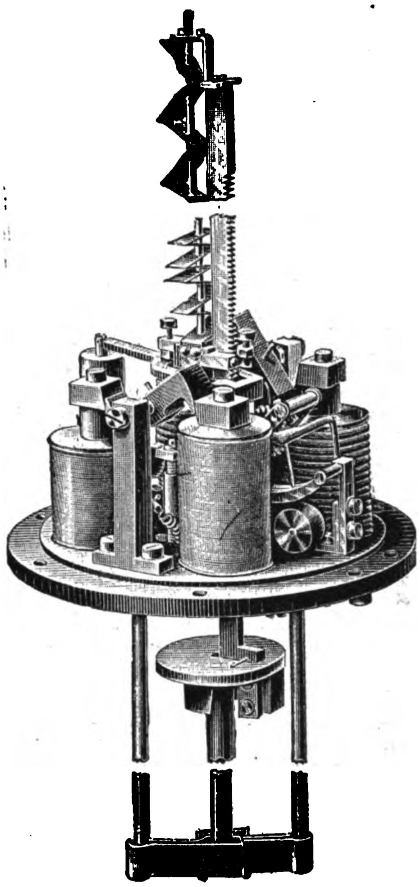


FIG. 3.—A. E. G. DIFFERENTIAL ARC LAMP.

direct current. The armature is drum wound and the core, instead of being notched or toothed, has longitudinal holes

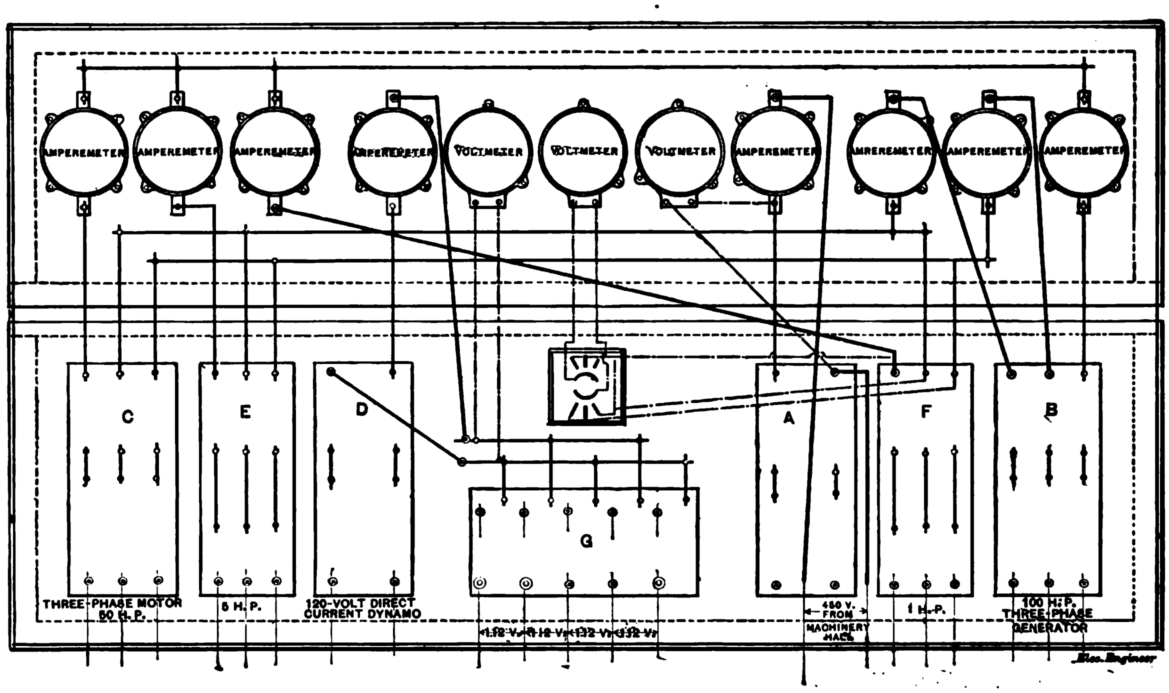


FIG. 4.—DIAGRAM OF CONNECTIONS, MAIN SWITCHBOARD.

bored through it near the circumference, through which the wires pass. The connection is of the open three-phase type, and the efficiency is claimed to be 92 per cent. including the direct current exciter.

Part of the current from this generator goes to a 50 h. p. three-phase motor directly connected by means of a flexible coupling with a 120 volt, 300-ampere direct current generator. The three-phase dynamo also drives a three-phase motor of 5 h. p. directly connected with a Sulzer pump, a 1 h. p. motor with a spring brake to show the torque under load, a ½ h. p. motor and one of ⅛ h. p. driving a fan at 700 revolutions. The three last machines mentioned are arranged to reverse

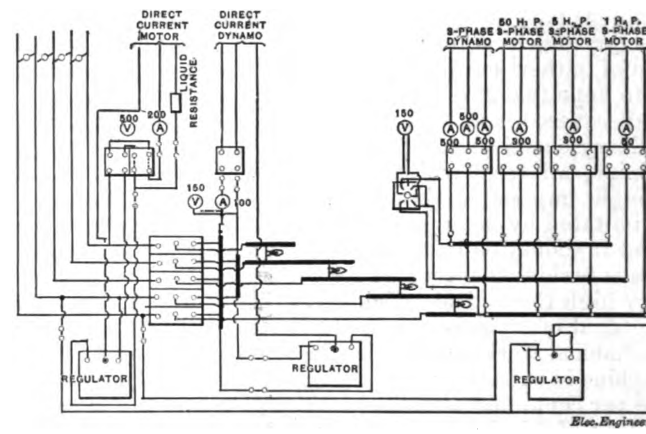


FIG. 5.—CIRCUITS OF DISTRIBUTING BOARD FOR 3 OR 5-WIRE SYSTEMS.

under load. All start under full load and only the two largest have starters. They are of the type that were used in the famous transmission work between Lauffen and Frankfort in 1891. Besides the motors this dynamo furnishes current to two 8-ampere alternating arc lamps.

The 300-ampere, 120-volt dynamo, mentioned above, operates 400 incandescent lamps and six arcs, two in series—two shunt and four differential consuming 10 amperes each—besides two other shunt lamps, the smallest ever built, taking but one ampere. The interior mechanism of the differential lamp is shown in Fig. 3. From this 120-volt circuit are run five direct current motors ranging from ⅛ to 6 h. p., all with self-oiling "ring" bearings. In these machines the poles are all connected by an iron ring completely surrounding the armature so that after the brushes are once set they remain fixed

and never spark under changes of load. A lot of cooking and heating utensils, cigar lighters, etc., three fan motors and a small drill are operated from this same current.

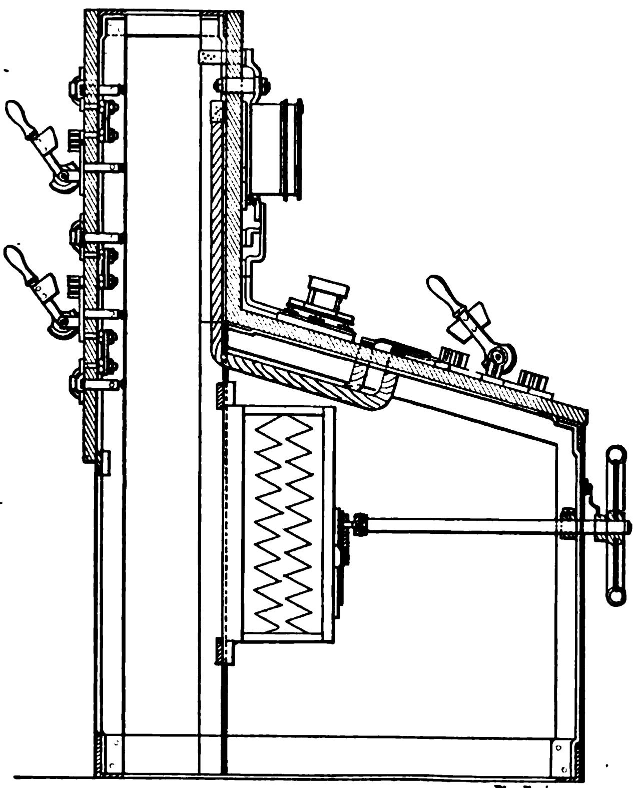


FIG. 6.—SECTION OF MAIN SWITCHBOARD.

The method of connecting the apparatus may be seen by referring to the switchboard diagram, Fig. 4. Here it will

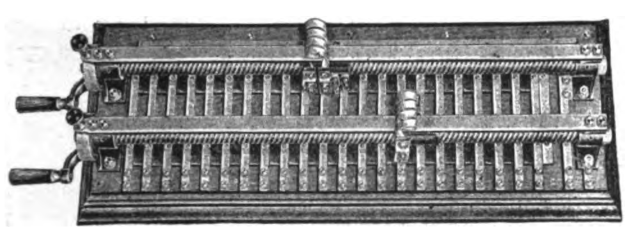


FIG. 7.—MULTIPLE ACCUMULATOR SWITCH.

be seen that the current from Machinery Hall enters at the switch A, controlling the large motor belted to the

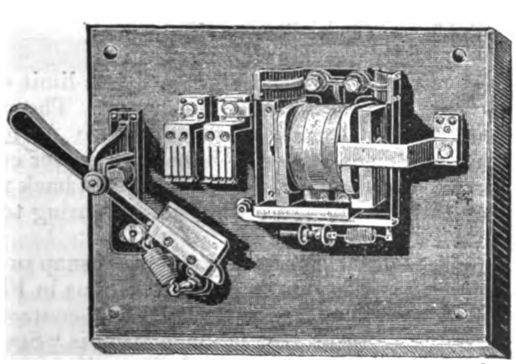


FIG. 9.—AUTOMATIC LIMIT SWITCH FOR HEAVY CURRENTS.

100 h. p. three-phase generator, whose switch is shown at B. The circuits from here may be traced, through the meters, to the switch C, that of the 50 h. p. three-phase motor coupled to the direct current generator whose switch is shown at D; to the 5 h. p. three-phase motor at E, and to the 1 h. p. motor at F. From D the current goes to the distributing switch G, whence it is sent out on either

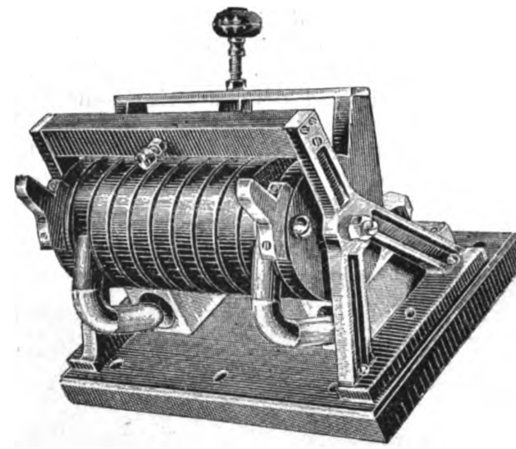


FIG. 8.—AUTOMATIC CUT OUT FOR MINIMUM CURRENT

the three or the five-wire system according to the position of the switch. The wiring plan to accomplish this is shown in Fig. 5. Fig. 4 shows the five-wire distributing board with

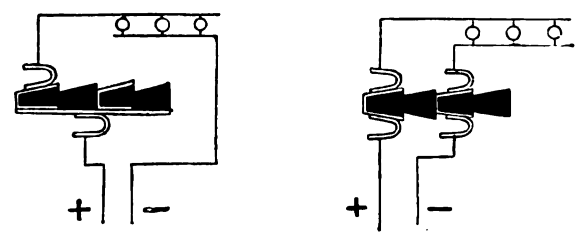


FIG. 10.

its connections. Fig. 6 is a section of the switchboard shown diagrammatically in Fig. 4.

We now come to the appliances. Probably the most conspicuous piece of apparatus shown is a large stage-light

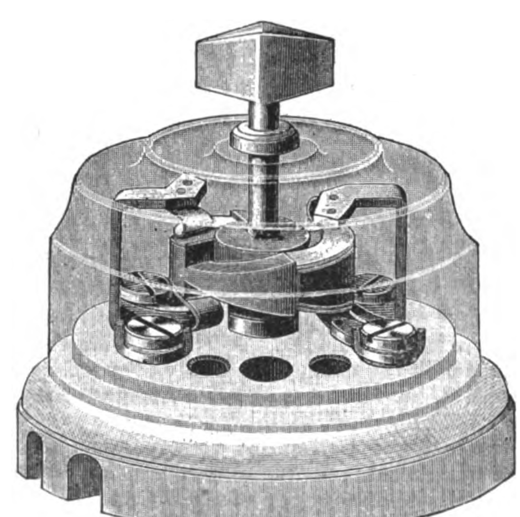


FIG. 11.—SINGLE AND MULTIPLE CIRCUIT SWITCH.

regulator for theatres by means of which any effect wished can be had by the ingenious combination of switches and resistances. Side, border and footlights are shown with this and twilight, moonlight, full sunlight, storms and lightning are imitated with remarkable accuracy. There are also small portable regulators for halls, etc., where the

large instrument would be impracticable or too costly; and projectors, reflectors and color boxes for stage lighting.

A train indicator, now coming into extensive use in Germany to announce the departure of trains from the railway stations, is also shown. The instrument is actuated by clockwork released at the proper moment by an electromagnetic device in the office of the train dispatcher. There are insulation test instruments ranging from 500 to 12,000,000 ohms with standard resistance boxes, standard dry batteries some of which have been in use for the past eight years, and other instruments for station testing. There are ammeters of from 15 to 2,000 amperes capacity and voltmeters for all potentials, portable ammeters for linemen, etc., voltmeters for storage battery work, a photographic registering voltmeter and a self-winding watt-hour meter. A clock-regulating system is shown in which the clocks are simply connected with the incandescent street circuit and are corrected once a day from the central lighting station.

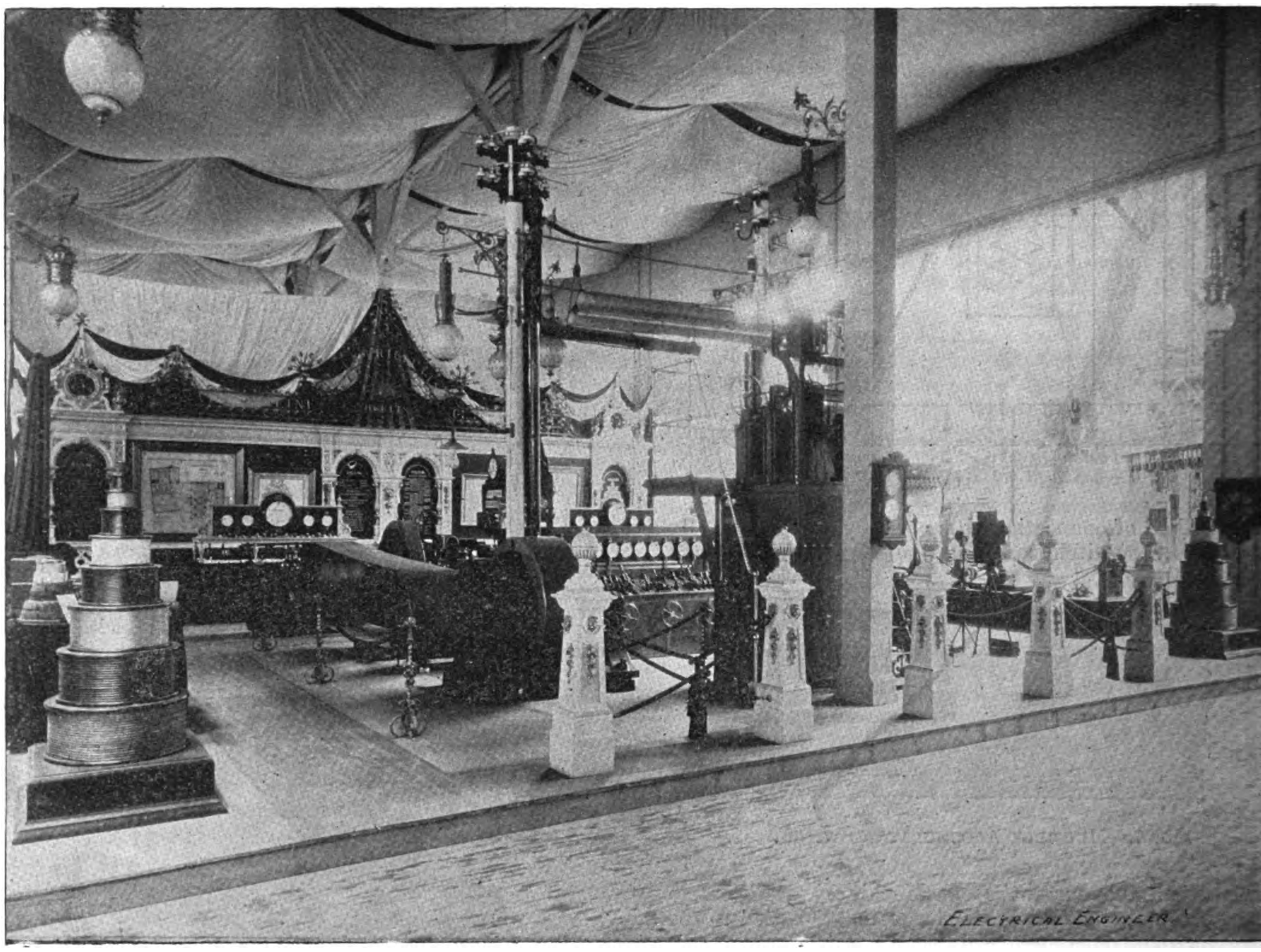


EXHIBIT OF THE ALLGEMEINE ELEKTRICITAETS-GESELLSCHAFT AT THE WORLD'S FAIR.

Considerable space is devoted to apparatus for use in connection with accumulators. There are controlling voltmeters, current indicators for charging and discharging, and several styles of charging switches. One of these, shown in Fig. 7, is so constructed that should the cells of a battery be unevenly discharged, or some exhausted while others are unused and fully charged, the current may be sent only into those cells requiring it and the others cut out of circuit by simply turning the handles at the end and placing the contacts in the proper position. The safety device, Fig. 8, is intended to cut out the accumulators should the dynamo belt slip or anything happen to the engine, and to prevent a flow of current back from the accumulator. It consists of a soft iron core surrounded by a coil of very heavy wire, of practically no resistance, through which the charging current passes, supported on bearings at its ends, on two brass brackets connected by an iron bar. The two ends of the coil dip into mercury cups and in this position complete the circuit. While the current is passing, the iron core is magnetized and its ends are drawn up against the fixed iron bar in front. Should the belt slip, however, there would be an instant when the current, in changing its direction of flow, would be nil and at this instant the iron core, being demagnetized, its ends fall away from the fixed bar, the terminals of the coil leave the mercury cups and the circuit is opened. Fig. 9 is a limit switch intended as a guard against theft of current. The switch, when closed, is held by an electromagnetic device set for a certain number of amperes. Should a greater current pass, the bar holding the switch lever is drawn back releasing the lever and allowing a strong helical spring to open the switch.

The principle of the single and double pole snap switches made by the company is shown in the diagrams in Fig. 10. They are made in all sorts and varieties. The contacts and contact plates are of brass and the insulation is "Stabilit," a preparation resembling vulcanized fibre, impervious to moisture and unaffected by heat. The construction of the switches is shown in Fig. 11. Knife switches, both double and single pole, are shown, up to 2,500 amperes capacity, and a quantity of house apparatus fusible cut-outs, etc.

Railway line apparatus is also shown; hangers, pole

heads, pull-overs, safety fuses, lightning arresters and car lamps. The appliances are all well made and are rather heavier than those in use here. An overhead distribution plan is shown at the tops of some high poles and can best be understood by reference to the engraving of the exhibit as a whole. A number of reels of wires and cables from heavy armored submarine lighting cable to lamp cord are shown and finally a quantity of miscellaneous specimens of insulation in stabilit and rubber. The former substance seems to be particularly adaptable to the manufacture of accumulator cells and several of these are also shown.

The display is under the direction of Mr. Jacob Stöttner and reflects the highest credit upon his skill and ingenuity as well as upon the recources of the Allgemeine Elektricitäts-Gesellshaft.

THE JENNEY MOTOR EXHIBIT.

In a somewhat sequestered spot on the ground floor of Electricity Building stand the beautiful little pavilion and exhibit of the Jenney Electric Motor Company, of Indianapolis, Indiana, manufacturers of constant pressure power generators, motors and dynamos for lighting and electroplating. Their space, "L, 2," at the southwestern end of the hall is divided into two sections, one for the pavilion and one for the exhibit, enclosed and separated one from the other by neat railings.

The machines shown are in operation. Current from a 50 h. p. 500-volt Jenney generator in Machinery Hall runs a 35 and a 20 h. p. motor each directly coupled to a 110-volt generator. The current from these goes to a marble switchboard, with a double set of bus bars and the necessary double pole switches, whence it is distributed to motors and incandescent and arc lamps.

On a pedestal near the board stands a ½ h. p. motor with a flexible shaft used for polishing, buffing, grinding, etc., and about the edge of the space are arranged a number of other small machines, among them a 300-ampere, 5-volt plating generator and motors ranging from 1½ to 12 h. p.

A new form of starting box for the motors, shown here for the first time, has in series with the motor field coil, an electromagnet to whose armature is fixed a lever preventing any movement of the contact arm of the resistance box until after the main line switch has been closed. The moment this is done, the resistance may be cut out in the usual way. When the contact arm reaches its last position it is held there by the other end of the lever controlled by the electromagnet until the circuit is opened, when the magnet drops its armature and the contact arm returns to its "off" position through the action of a coiled spring. In case the current should be suddenly broken or accidentally cut off when no one is present, the box will operate automatically and thus there is no danger of burning out the motor armature when the circuit is again completed.

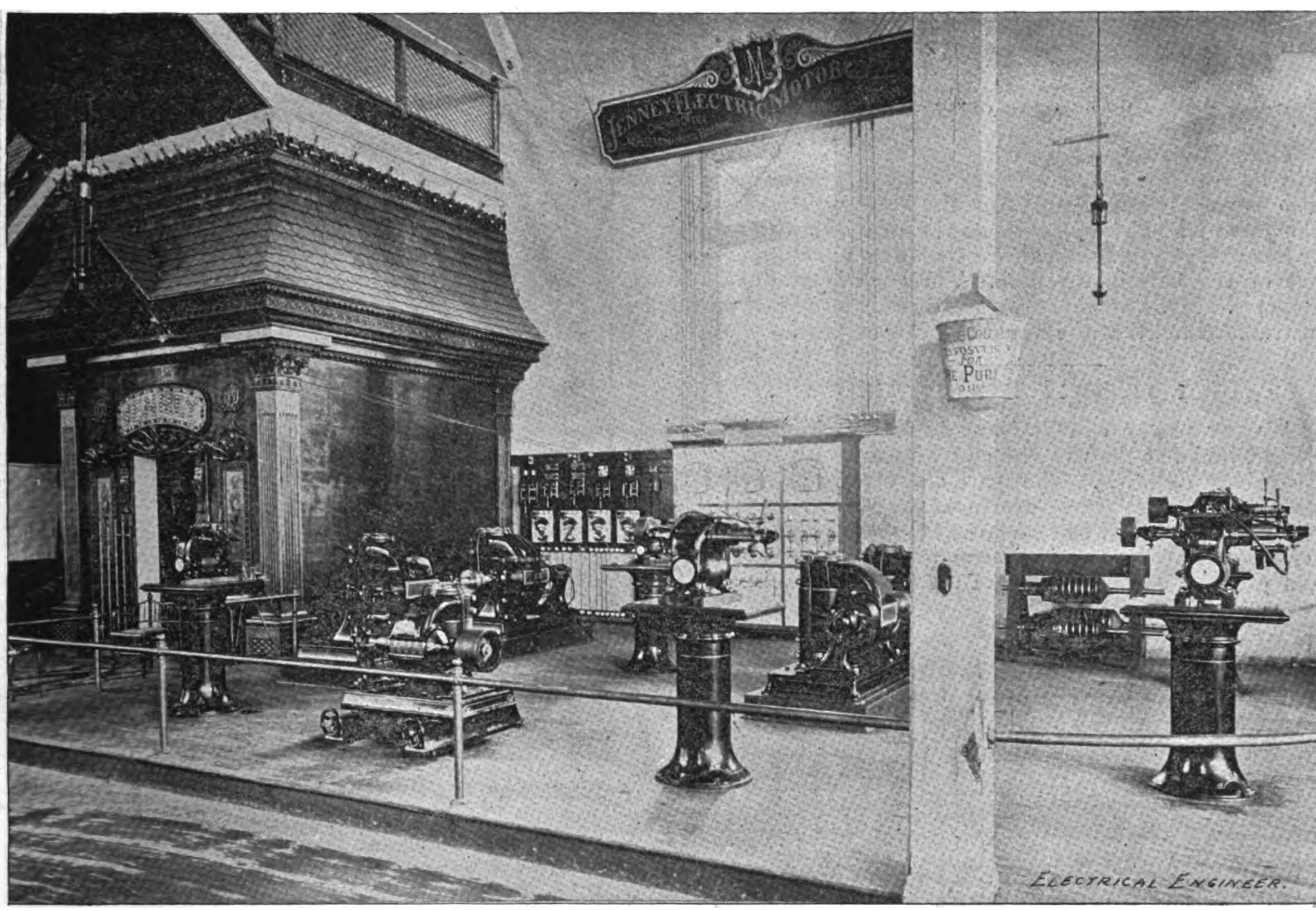


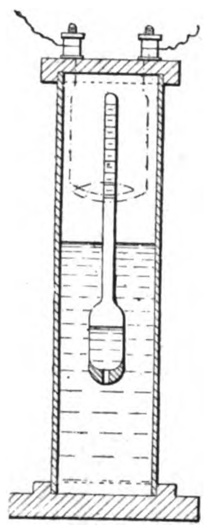
Exhibit of the Jenney Electric Motor Company, World's Fair, Chicago.

The office pavilion is a cozy little building made of papier maché in excellent imitation of hammered copper. The outer walls are ornamented in repoussé work and above the door is the single word "Jenney" made in stage jewels, an inch and a half in diameter, lighted from the back with excellent effect. Groups of lamps about the door and a cornice near the eaves complete the exterior lighting. Within, the decorations are in white and gold and are very tasteful and pretty.

Mr. A. H. Goode, the western manager of the company, has control of the exhibit, though it is under the immediate charge of Mr. L. A. Farnsworth, who is at pains to have the merits of the Company's apparatus thoroughly understood by all visitors.

THE "CARTESIAN" AMMETER.

A CLEVER little arrangement for the measurement of current, intended especially for lecture-room use has been devised by Mr. J. G. Lorrain, of London, who is at present at the Fair.



THE "CARTESIAN" AMMETER.

The principle is exactly that of the Cartesian diver, as will be seen by a glance at the accompanying engraving. The current passing through the coil surrounding the elongated part of the float heats the air within to a greater or less extent and forces a corresponding amount of water out of the hole in the bulb. The neck is graduated in amperes. Mr. Lorrain says that there is no patent on the instrument and that the world is welcome to it.

PAISTE SWITCHES AT THE FAIR.

A VERY pretty exhibit is made by H. T. Paiste, of Philadelphia, at the western end of the south gallery of Electricity Building. The space occupied is mainly on the wall with a small enclosure in front for an office. The architecture, as will be seen from the engraving, is in the style of the Italian renaissance and the coloring is of ivory and gold. The background of the wall space beneath the

THE H. T. PAISTE EXHIBIT AT THE WORDD'S FAIR.

pediment is of pale blue felt upon which is outlined the "eccentric" movement of a switch in ceiling cut-outs, together with the words, "Xntric, that's the switch."

Within the railing at either end stands an easel, one supporting a polished oak board showing the evolution of the Paiste switch from the early experiments to the present form, and the other also bearing a board with the names of Mr. Paiste and his switch. Back of this will be noticed a board showing samples of main and branch cut-outs. At the left of the entrance is a "tester" to show the durability of the switch, consisting of a small motor attached to the spindle and a tachometer showing the number of revolutions.

The exhibit is in charge of Mr. E. A. Jenkins.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, of New York City, of which Mr. S. Bergmann is president, have made quite a large display of their low voltage lamps at Section E, 6, Electricity Building. The company make a

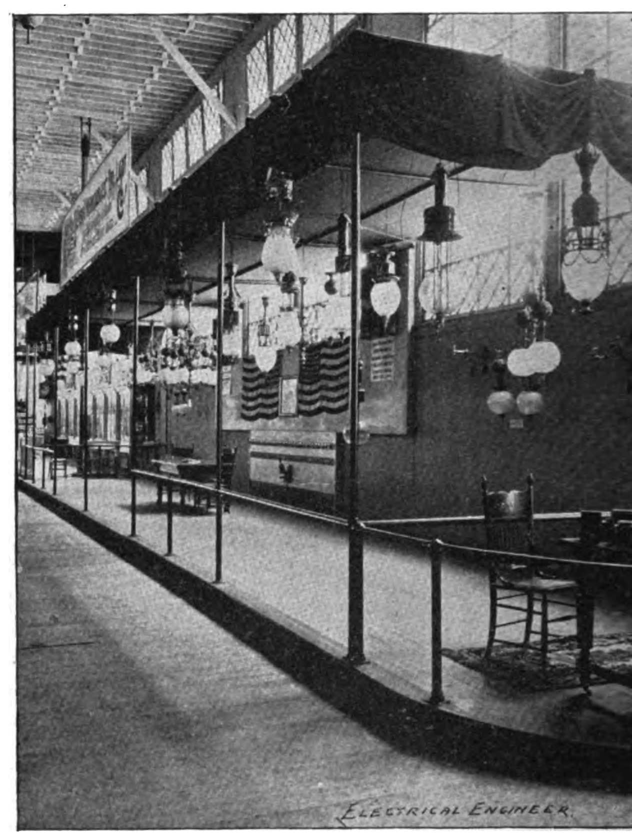


EXHIBIT OF THE GENERAL INCANDESCENT ARC LIGHT CO.

specialty of ornamental lamps for interior lighting, and show a great variety of styles in brass, bronze and iron, made up both as electroliers and as wall brackets. Current at 110 volts is received at the switchboard where 30 snap switches distribute it to the lamps. The standard lamps are adapted to be used two in series, where the voltage is from 100 to 125, each arc being maintained at about 43 volts and the remainder of the potential taken up by the resistance which is mounted on the lamp frame. If desired, the resistance may be also supplied as a separate device, one resistance for each pair of lamps. On three-wire or 220 to 240 volt circuits, the standard lamps are used five or six in series, and on railway circuits, which have a voltage of 500, they are used 10 to 12 in series, and each lamp in the series is provided with a cut-out.

Besides the standard lamp there are shown chain lamps which dispense with the rack rod and employ a chain wound on a drum to carry the carbon. This, of course, lessens the length of the lamp and adapts it to low ceilinged rooms and other places where the height is limited.

Then there is the "Bijou" lamp for decorative lighting, said to be the shortest arc-lamp made. This is made in sizes from 200 candle power up, making it particularly desirable for interior lighting owing to the ease with which the illumination may be distributed. In this, as in the chain lamp, the resistance is usually a separate device but can be mounted in a canopy if desirable

The decorative character of the lamps displayed may be seen from the engraving of the exhibit on this page. Besides this there are 160 of the company's lamps on a 500-volt circuit in Machinery Hall, placed 10 in series.

The Western office of the company is at 169 Adams street, Chicago, and the World's Fair exhibit is in charge of Messrs. C. A. Noll and L. E. Frorup.

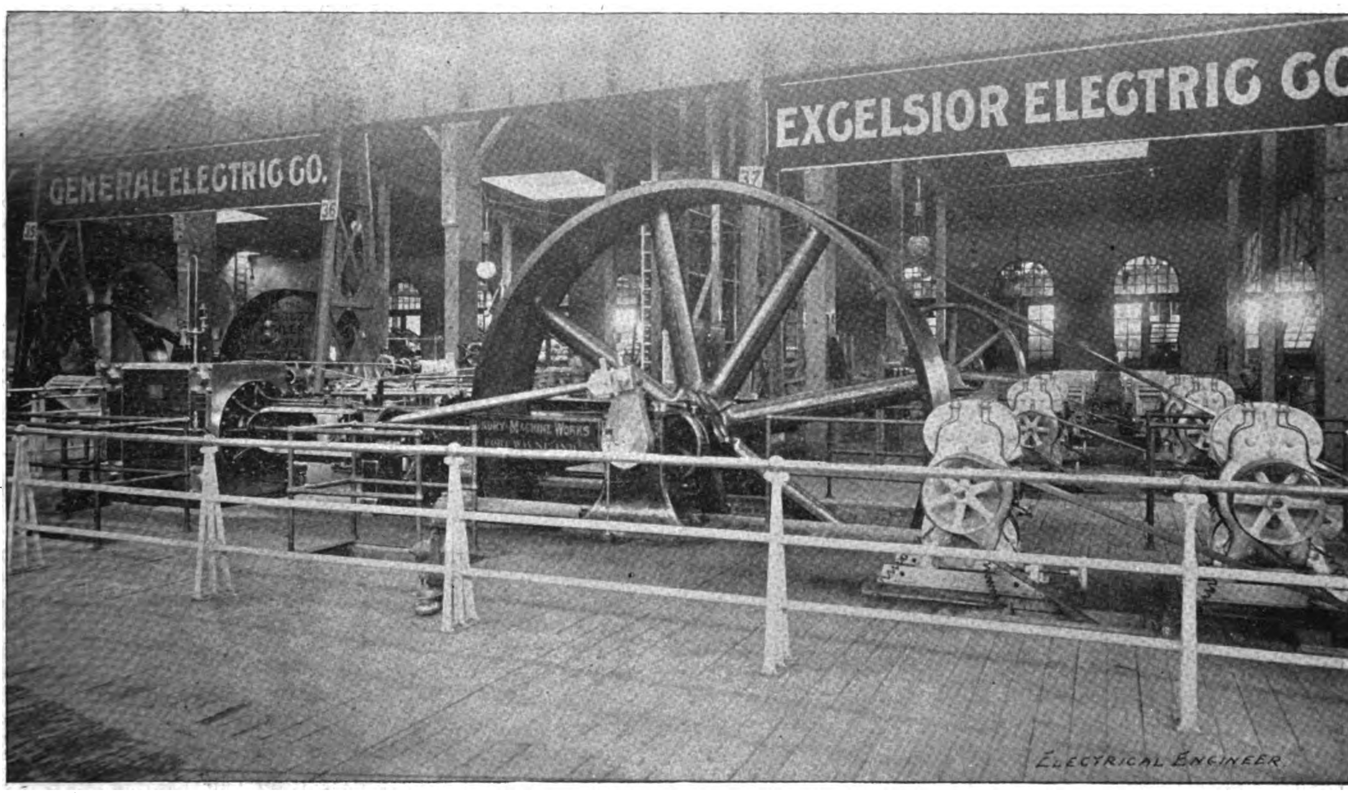
EXCELSIOR LIGHTING AT JACKSON PARK.

One of the best lighted buildings at the World's Fair is that devoted to Horticulture, and as its lighting is done by the Excelsior Electric Company of New York, it follows that the service installation of the Excelsior Electric Company is one of the best managed lighting plants on the grounds. This deduction is not only logical but also true. The plant is in the annex to Machinery Hall and consists of a Bass compound engine of 350 h. p. belted to a countershaft beneath the floor, from which are run six 50-light 2,000 c. p. Excelsior generators[1] by means of friction clutches.

From these machines the current is led to six wall controllers and thence out to the lines. Four circuits go directly to Horticultural Hall where there are 197 lamps advantageously arranged, one to the grounds southeast of the Government and Fisheries Buildings, and the last divides, supplying fifteen lamps to the western edge of the grand basin and 25 to the South Canal.

The illustration on this page shows the generating plant, which, together with the exhibit of motors and lamps in the Electricity Building, mentioned in The Electrical Engineer of May 17, is under the charge of Mr. G. H. Almon, the company's representative at the Fair.

1. For a complete description of this machine see The Electrical Engineer, April 23, 1890.



Arc Lighting Plant of the Excelsior Electric Co., at the World's Fair.

THE BRUSH, SHORT AND SPERRY EXHIBITS.

In the southwest corner of the Electricity Building, the largest and most striking display is made by the Brush Electric Company, of Cleveland, together with the Short Electric Company and the Sperry Electric Railway Company. In the middle of the Brush space rises a beautiful Corinthian temple used as a reception room. This is one of the most ornamental features of the Electricity Building and ranks very close to the Bell Telephone temple in beauty of design. It is wholly without windows and is lighted within by a circle of incandescent lamps at the base of the dome, concealed from view and casting their light upward. The dome is painted to represent the sky covered with soft, fleecy, transparent clouds, and the light, reflected from this blue surface, looses its yellow effect and falls in a delightful white glow about the room.

The apparatus shown surrounds the temple, extending back for some distance. Current at 220 volts from Machinery Hall runs to a 25 h. p. motor coupled directly to a 3,000 light alternator. The current generated by the alternator goes directly to the lamps at 110 volts, without passing through a transformer. This is managed by a very simple arrangement. In the machine described the armature has 10 bobbins and about the entire frame of the generator extend two bus bars to which the ends of the windings are connected in parallel.

Just back of this is a 50-light arc machine driven by a directly connected crane motor. This furnishes current to the exhibit lights or alternately to a lot of arc generators sometimes run as motors. Beyond this is the working switchboard of white marble. At the front are the switches for the power and direct current circuits, the latter arranged to be changed instantly from the two to the three

wire system, or vice versa, while at the end are the arc circuits for all the exhibit lights. The fuses are at the back of the board.

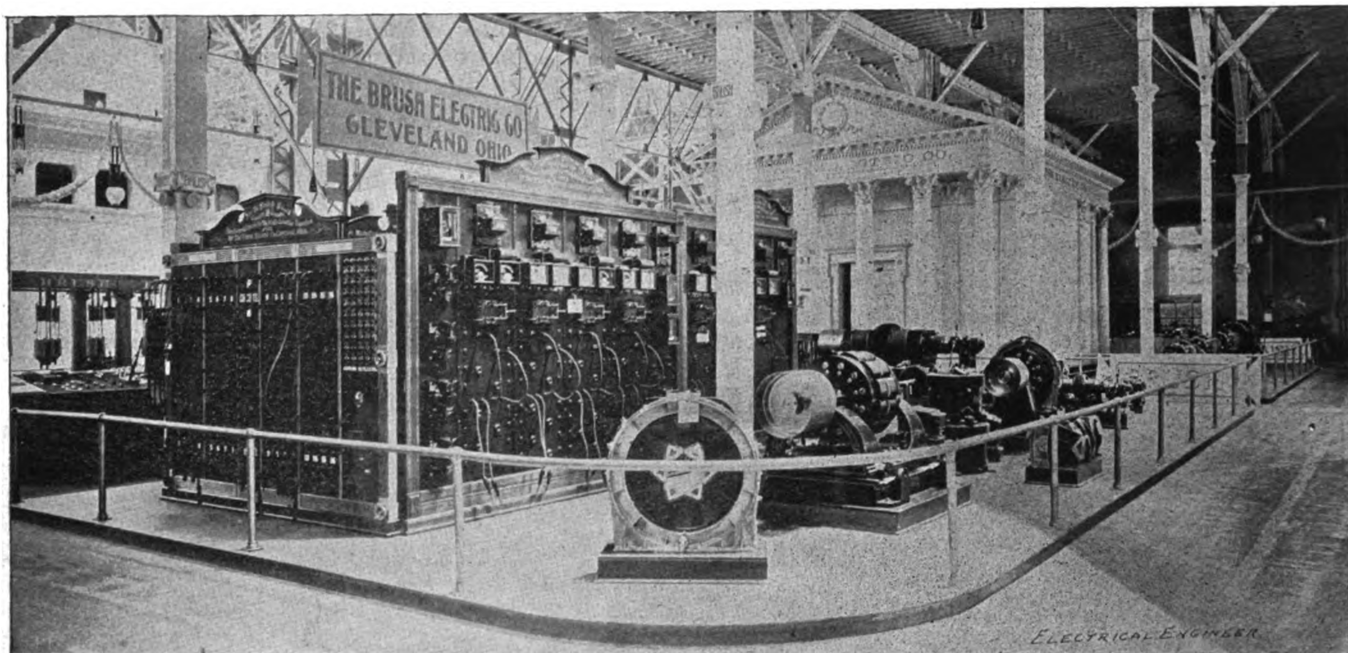


EXHIBIT OF THE BRUSH ELECTRIC CO. AT THE WORLD'S FAIR.

Forming part of the exhibit are several historic machines illustrating the durability and excellent construction of the Brush apparatus of the earlier days. The first of these is a small two-light machine bought by Messrs. Davis & Watts, of the Viaduct Manufacturing Company of Baltimore, Md., in 1877, and used steadily ever since. It is still

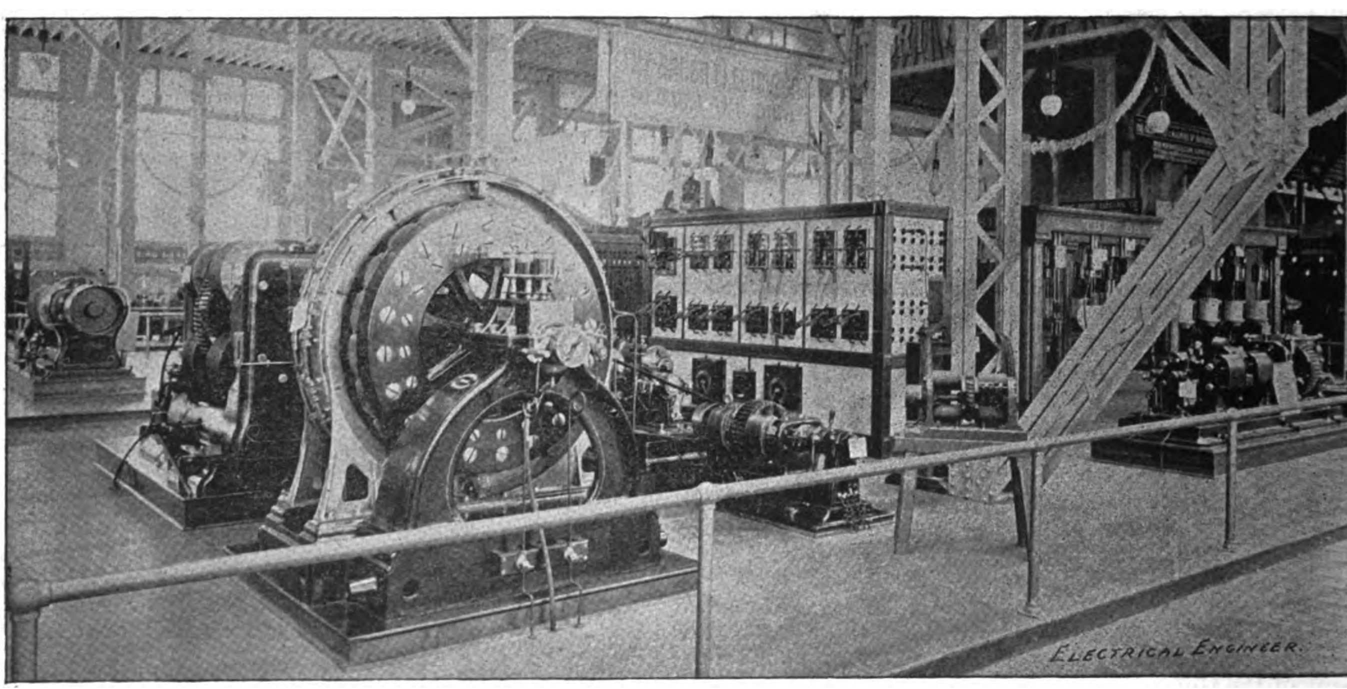


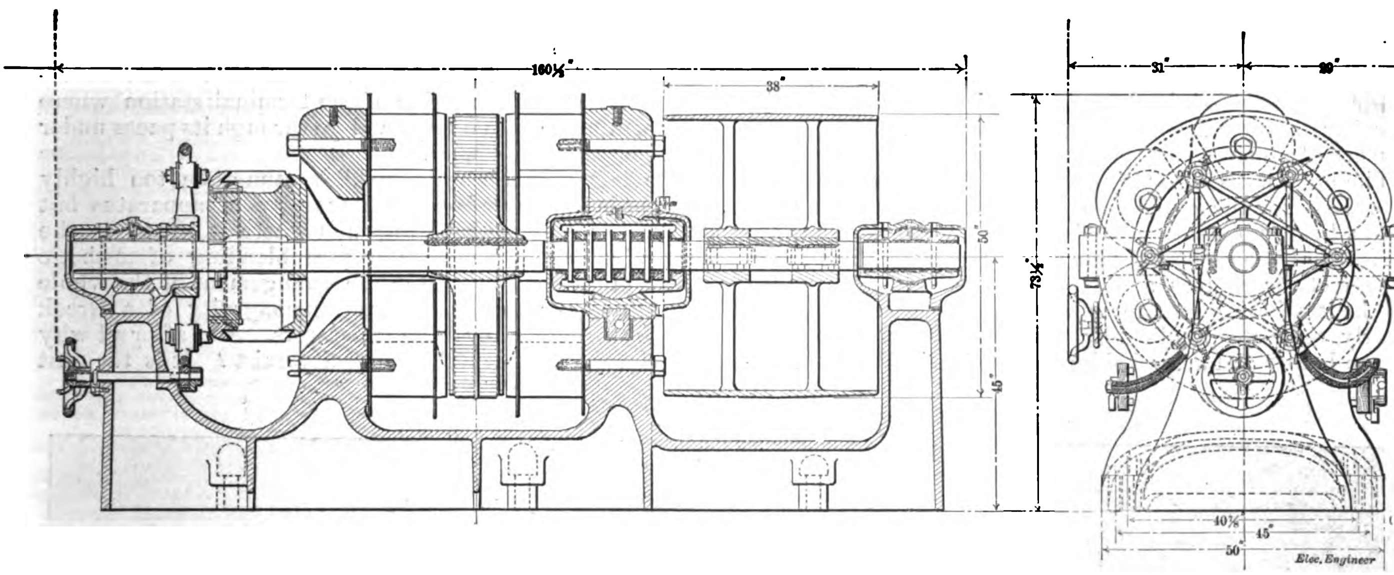
EXHIBIT OF THE BRUSH ELECTRIC CO. AT THE WORLD'S FAIR.

in good order and was only taken out because two lights were no longer sufficient. A large fac-simile of the letter accompanying this generator when it was returned, says: "We part with our little friend regretfully but consider that it is going home to rest and will be better preserved than with us." A 16-light 2,000 c. p. arc machine is also shown that has been in constant operation in the Fulton Worsted Mills, at Fulton, N. Y., since Sept. 1, 1879, and is now furnishing current for exhibit lights. The Berkley Company, of Providence, R. I., have contributed a 40-light arc machine and 10 arc lamps that have lighted their factory since December 1, 1881, and are still in practically as good condition as when they were new. In order to exhibit them the Brush Company gave the Berkley people a new generator and new lamps in exchange for the old.

At the right of the temple are arc machines of from one to 60 lights capacity, and on the left are the incandescent

generators with capacities of from 2,000 lights down to 400. In the rear space again to the left of the apparatus already described are crane motors, mining motors, exciters, alternators and converters, the last ranging from five to 250 lights capacity. To the right of these are the switchboards for the alternating and arc circuits. These have iron frames and all sections are interchangeable. Any circuit may be thrown on any machine, as will be explained further on. The plugs used on this and the other plug boards have insulating sleeves covering the metallic part except when inserted in the board when the sleeve, being too large for the socket, slides back as the contact is made. Commutators, field magnets, etc., fill the rest of this part of the space and on a counter are displayed small parts of lamps and miscellaneous apparatus. A lamp rack showing differerent styles of arc lamps and having a separate switchboard, completes the Brush display.

In the space devoted to the Short Electric Company the most striking piece of apparatus is a 450 h. p. 50-inch generator of a new type, shown in detail above. This machine delivers 600 amperes, has a speed of 300 revolutions and is wound for 10 per cent. loss. The collar bearing on the armature shaft for close adjustment, is one of its claims to orginality, the good points of which will be readily appreciated. This is the latest motor designed by the company, and aside from the construction of the shaft and the adjusting device differs from its predecessors in several minor details that may be seen by a comparison of the working drawings with those of the well-known type. In this space is shown the original gearless motor, followed



50-Inch Short Electric Railway Generator.

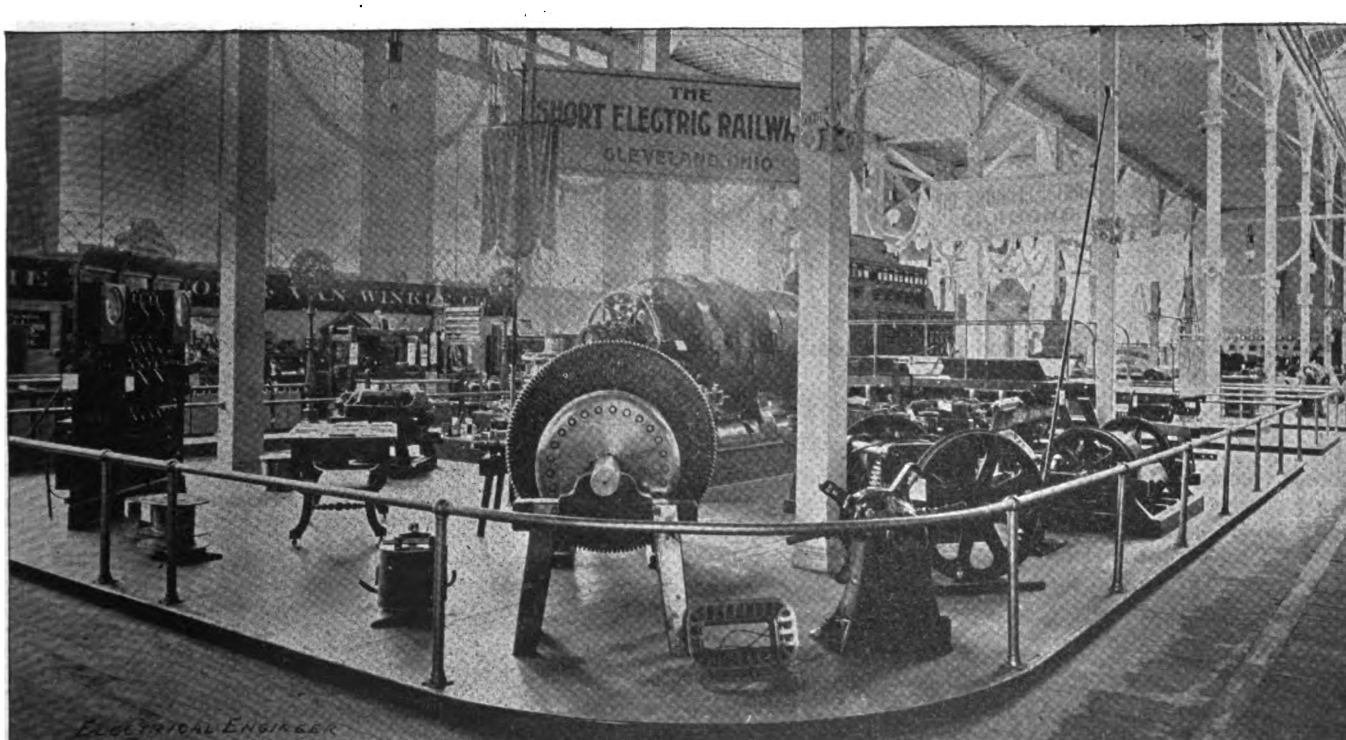


Exhibit of The Short Electric Co. at the Fair.

by two improved forms, and finally by the perfected machine of to-day. Here are also single reduction motors, rheostats, etc., and small parts of machines, and at the rear stands a platform car with two gearless 35 h. p. Short motors. At one corner of the space is an iron frame slate switchboard with ammeters, circuit breakers, fuses, rheostats, etc.

Directly north of the Short section is the carbon exhibit, showing lamp carbons and carbon dynamo and motor brushes of all sizes.

The large switchboard just back of this space was made expressely for the exposition and is designed for 30,000 lights, being no less than 30 feet long by 12 feet high.

North of the carbon display is the Sperry exhibit showing street car motors and their construction. Two men are kept winding armatures where the operation may be clearly seen and studied by visitors, and armatures are shown before and after baking, and also in different degrees of completion. Then come the motors themselves and their method of attachment to the truck.

Exhibit of The Sperry Electric Co. at the Fair.

The fundamental points of the Sperry system as shown here are the single motor, elastic support and flexible connection. The standard motor is a 40 h. p. four pole machine, that is, it has two field spools and two salient and two consequent poles. The armature is of large diameter giving a good torque; it is of the Gramme ring type iron-clad and cross connected so that only two brushes are required and these are placed at the top where an opening is left in the iron case. The motor is supported on cross pieces whose ends rest on elastic cushions at the sides of the truck frames so that its entire weight and about two thirds of that of the gears, housings and clutch are carried by the truck and the only direct weight on the axle is that of the large gear and part of the housing. Both bearings of the pinion shaft are contained in the housing so that bevel and pinion must always move together and consequently always mesh perfectly. The flexible clutch is an invention of Mr. Sperry's to allow for the vibration of the armature shaft in relation to the pinion shaft. This is necessary as the motor is flexibly mounted on elastic supports while the gearing is nearly rigid. The flexible coupling also permits the slight departure from correct alignment at curves, taking the strain from the gears and running noiselessly at all times.

Two of these motors are shown mounted, one on a McGuire and the other on a Dorner & Dutton truck jacked up to allow the motors to be operated. In addition to this exhibit, where the motors are left open that the parts may be examined while in motion, there will soon be an exhibition track at the north side of the terminal station where a car will make actual trips and go through its paces under conditions of real service.

The details of this entire exhibit cannot be too highly commended. There is a great quantity of apparatus but everything is where it belongs and where it shows to the best advantage. There is a rare blending of æsthetic taste and mechanical skill in the arrangement of the whole that blinds one to the apparent incongruity of a Greek temple surrounded by Ohio generators. And after all why should any fundamental incongruity exist? It is the past saying "well done" to the present; the union of beauty and utility, of art and science, of ancient perfection and modern progress.

THE ELECTRICAL JURY OF AWARDS.

The electrical jury has been divided into subcommittees each of which will take up some particular class of apparatus, as follows:

Subcommittee I.—Apparatus of precision and demonstration, ammeters, voltmeters and transformers. Professors Ayrton, Stine, Mendenhall, Rowland, Owens and Thomas.

Subcommittee II.—Primary and secondary batteries. Professors Dolbear, Shrader and Stine.

Subcommittee III.—Dynamos, motors, applications of power and transmission. Professors Forbes, Carhart, Ryan, and Jackson, Director Rathenau, Lieut. Reber and Dr. Emery.

Subcommittee IV.—Arc and incandescent lamps. Professors Thomas, Ayres, Tompkins, Owens and O'Dea and Baurath Ulbricht.

Subcommittee V.—Electro-metallurgy, electro-chemistry, and electric heating and welding. Professors Ayres and Barker, Director Rathenau and Mr. Warner.

Subcommittee VI.—Telegraphs, telephones and signaling apparatus. Professors O'Dea and Ayres, Baurath Ulbricht and Mr. Pope.

The name of Mr. Adolpho Aschoff, the secretary of the Brazilian Commission, has been added to the list of electrical jurors.

The preliminary report of Subcommittee III, to judge dynamos, motors and the transmission of power, drawn up by Dr. Charles E. Emery, is given below, and shows the regulations adopted and methods to be employed in conducting the tests:

REGULATIONS RELATIVE TO TESTS OF THE LARGER DIRECT COUPLED ENGINE DYNAMOS.

Preliminary Statement.—It is proposed to test a number of the larger direct coupled engine dynamos for the purpose of ascertaining the consumption of steam and the electrical and commercial efficiencies of the apparatus under various loads. Tests of smaller apparatus of this kind may be decided upon later, but arrangements for the same are not yet completed.

Tests will generally be made for the purpose of helping the jury to form an estimate of the value of the exhibits. Where the jury are able to come to a conclusion without carrying out such tests they may grant awards based on an examination of the exhibits. It will only be practicable, in relation to the particular exhibits referred to herein, to test such representative apparatus as is located favorably in relation to steam supply and can be operated under a desirable load. It is, therefore, to be understood that the awards on the apparatus for which tests are herein provided are to be "granted upon specific points of excellence or advancement," the same as other exhibits, but that an abstract of the general results of the tests will be added to the report for an award, with references to the detailed reports on the subject.

Apparatus to be tested[1]. The apparatus which it is proposed to test is as follows:

(*a*.) One 750 kilowatt, 500 volt, compound wound General Electric generator, with a vertical Lake Erie engine, situated in the Intramural power station.

(*b*.) One triple compound vertical Edison engine, marine type, with Corliss valve gear, directly connected with two 400 kilowatt, 160 volt armatures, shunt wound, for service on the Edison three-wire system.

(*c*.) One horizontal compound Reynolds engine, with one kilowatt, 500 volt, compound wound Westinghouse generator.

(*d*.) One of the 10,000 light Westinghouse alternating current dynamos, directly connected to a Westinghouse, Church, Kerr & Co., 1,000 h. p. compound condensing engine.

(*e*.) One 500 volt, direct current, Siemens & Halske generator directly connected to a 1,000 h. p. engine of marine type, located in Machinery Hall.

General description of tests. There are to be three classes of tests of each apparatus, to be designated A, B and C.

"A" Tests: Not less than one or more than three complete tests are to be made with each apparatus to ascertain the economy in the use of steam and the relation of the indicated h. p to the electrical output. One of such tests to be made with a load corresponding substantially with the maximum efficiency, one near the minimum allowable load and one near the maximum allowable load.

"B" Tests: Partial tests, supplementary to the above, without measuring the water evaporated but varying the load by gradual increments through the practicable range, to be made for comparing the indicated h. p. with the electrical output.

"C" Tests: These tests are designed to aid in distributing the energy developed in the engine, in excess of that shown by the total output in watts to include friction tests of engine and a determination of the resistance caused by exciting the field with the main circuit open; they include also tests of electrical resistance, heating of armature, field, etc.

Order of Tests.—The apparatus to be first operated at substantially six-tenths of its maximum load for at least four hours before commencing the tests. The first complete or "A" test is then to be made, to be followed by the minimum "A" test, and that followed by the maximum "A" test. In case all of these tests cannot be made in succession the rule as to operating the dynamo four hours at six-tenths load is to be followed previous to each test. The same preliminary run to be made also before commencing the "B" tests.

Details of Tests.—The "A" tests are substantially of two hours duration. At the beginning and end of each "A" test all conditions are to be maintained as nearly as possible, including the steam pressure, but to insure that all water in the boiler has become heated and swelled to correspond with the temperature the water level is to be allowed to raise a little higher in the gauge glass at the beginning and time called, and the test actually started as the water reaches a definite mark. The same course to be pursued at the close of the test and the calculations based upon the actual difference of time. During each "A" test all the water pumped into the boiler is to be measured in suitable tanks. The load is to be maintained constant and indicator diagrams taken from the engine cylinders every 10 minutes, and the time carefully marked on the same. All the current generated to be measured by a single ammeter in addition to which an ammeter is to be placed in the shunt field circuit and another, or an equivalent, in the shunt of the series field, if one is provided. A standard voltmeter to be connected with the main armature terminals. For the alternating current dynamos a standard wattmeter to be used in connection with the ammeter and voltmeter. Velocimeter and engine counter to be connected with the main shaft. The ammeters and voltmeter to be read every minute and an average of such readings and the reading of the engine counter recorded in the log every 10 minutes.

"C" Tests: At the conclusion of a run during which the engine has been operating smoothly, the current is to be cut off of the main and field circuits, the field magnets made neutral by passing an alternating current through the coils if necessary, all stuffing boxes about engine containing flexible packing slackened and friction diagrams taken for about fifteen minutes with engine running at normal speed and steam throttled so that it will be automatically cut off near the middle of the stroke and prevent the formation of looped diagrams. The field is then to be excited and indicator diagrams taken to compare with those of the previous runs so that from the difference in area there may be deduced the losses due to hysterisis, to Foucault or eddy currents, as well as the mechanical resistance due to eccentricity, etc. During these experiments records of the voltage to be taken for a time at the main terminals and again for a time, for armatures provided with multiple double parallel circuits, the leads connecting brushes of like sign to be removed and the voltage shown at the terminals of the several double parallel armature circuits to be observed and recorded for the purpose of ascertaining the influence of joints, blow-holes and variations in the permeability, etc., of the pole-pieces or yokes, or of other conditions affecting the symmetry of different parts of the field.

The resistance of the armature and series field circuits to be determined with engine at rest and considerable current flowing by observing the drop of potential with a sensitive voltmeter due to a given current. Resistance of the brushes when running to be approximated by connecting a millivoltmeter between the brush terminal and an extra hand brush on the edge of the commutator opposite the brush tested.

Heating.—The "C" tests, with field excited, to be continued until the armature core attains a normal temperature, which is to be noted together with such observations as are found possible as to the rate of the rise of temperature compared with that of the air. The temperature of the armature to be also observed at the beginning and end of the several "A" and "B" experiments.

Organization for Conducting the Tests.—The tests in each case to be in general charge of a particular judge designated for the purpose. A number of judges designated as expert observers are to take such of the data as found practicable and certify the same. Expert assistants, preferably from the technical schools, to be engaged to take the remaining data. If practicable the force organized by the judges of the Department of Machinery to take indicator diagrams may be employed for the same purpose in connection with these tests.

Publicity of Tests.—The instruments used, to be of large size so that they may be read at a distance, and so far as practicable the companies represented may each have an expert observer to take each class of data in connection with the judge, or observer, detailed for the same. In case a mistake is detected, or if from any cause the apparatus in any detail is not operated properly or as prearranged, the attention of the judge in charge is to be immediately called to the same so that the mistake may be corrected or the experiment repeated at once. Protests as to facts made at a later period cannot be considered.

Standardization of Instruments.—In case the judges or the Department of Machinery arrange to take indicator diagrams and standardize the indicators the judges of this department to cooperate with them in securing proper standardization, otherwise efforts to be made to have the same standardized by the Bureau of Steam Engineering of the Navy Department with the apparatus they provide for the purpose, or the work will be done under the direction of the judges with such apparatus as can be borrowed from instrument manufacturers and the technical schools. The electrical instruments to be standardized by judges of the group who are to report on this class of instruments and the results to be certified by the same.

Reporting the results.—The exhibitors are to furnish the judges with small drawings of the apparatus tested, sufficiently in detail to convey to those familiar with the subject an accurate idea of the type and general dimensions of the apparatus. Conferences are to be had with exhibitors to see if they are willing to furnish particular information as to the quality of materials used, area of the different portions of the magnetic circuit, exact size of the conductors, the method of winding, the number of turns, methods and extent of insulation, etc., and if so this information to be embodied in the report. The reports are to at least show in condensed form the general results obtained in each class of test—all reduced to the same standard as to time and units. Conferences to be had with exhibitors to ascertain whether or not it is desirable to embody in the report the actual percentages of efficiency obtained under different conditions or simply to state the results from which those familiar with the subject can calculate such percentages.

1. Several of the tests are dependent upon the consent of the engine builders, and upon the boiler manufacturers to supply steam at the necessary pressure.

PREPARATIONS FOR THE INTERNATIONAL ELECTRICAL CONGRESS.

THE work of preparing for the International Electrical Congress which meets at Chicago on August 21, is going actively forward. As there are many inquiries with regard to railroad facilities, etc., Dr. Elisha Gray, president of the Advisory Council, has appointed Mr. C. O. Baker, Jr., chairman of a transportation committee, and Mr. Baker, whose successful work in this field is so well known, has kindly consented to serve. His headquarters will be at the office of the National Electric Light Association, 136 Liberty street, New York City, where secretary Porter has placed all the facilities at his disposal. Mr. Baker is now preparing a circular of information for the special benefit of Eastern members of the Congress and their friends. In all probability a large Congress Special will be run.

The Congress Committee on Invitations has accomplished the heaviest part of its work although it expects to be busy up to the very opening of the Congress. It has issued nearly 950 individual invitations, of which about 600 are American and Canadian including some of the foreign electricians attached to the World's Fair. It has also issued general invitations to 12 foreign electrical and scientific societies, with a membership of perhaps 3,000 or 4,000, but of these a very small proportion may be looked for. It is believed that the Congress will muster, however, not less than 500 strong, or even more. All the individual invitations have been canvassed by the Committee on Invitations and by President Gray, and it is safe to say that a more representative list of scientific and professional men, as well as of those of large practical interests, was never before got together, so far as America and Canada are concerned. The foreign element of the Congress will be large, all told, and more distinguished even for reputation and influence than for its numbers. The programme of papers and topics for the two Chambers is in preparation, and will be issued shortly before the Congress convenes. Everything points to a most brilliant and successful Congress at Chicago.

SCHIEREN BELTS AT THE FAIR.

CHAS. A. SCHIEREN & Co., write us with regard to their exhibits illustrated last week: "We have at the Fair an aggregate of 60 belts in actual use, running dynamos, motors and generators, all of our "electric" and "perforated" grade, and running in size from 72 to 12 inches wide, two to three play. We have more belts in actual use in the Fair, and the World's Columbian Exposition people have bought more belting of us, than any other two houses in the trade put together."

C. P. LOCKSTAEDT, who underbid the General Electric Company a million dollars on the World's Fair lighting and then turned his contract over to the Westinghouse Company, has been getting into trouble with paper on which he had forged the endorsement of general manager Bannister. He has victimized the banks in Chicago to the tune of $88,000 and has left for parts unknown.

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THE ELECTRIC ARC.

A NUMBER of able experimenters have sought to explain the phenomena which have been observed in the electric arc, and various assumptions have been made to fit them. Edlund's experiments and the formula which he promulgated are perhaps the best known among these, but later investigators have differed from him both in the explanation of the arc phenomena and in their numerical formulation. In this issue we print a highly interesting account of a research on the same subject by Messrs. Duncan, Rowland and Todd. The results obtained with the arc under various conditions of current, potential difference and surrounding pressure are well worthy of careful study by those engaged in arc lighting work. The reference to the contrast in the results obtained with cored and solid carbons, and, in general, to the effects of different carbons goes to confirm the experience long since gained abroad but unfortunately still ignored by the majority of arc light users in this country.

THE OCONTO LAMP DECISION.

JUDGE Seamans's decision of July 20 has now been before the public for a week and all who are interested have had opportunity to examine it. We infer that the Court found no small difficulty in arriving at a decision satisfactory to itself in view of the conflicting evidence presented. But it is easy to understand and appreciate the considerations that led to the conclusion reached. The Edison patent is nearing the end of its term; it has been several times upheld by the courts, including the Federal Appellate Court at New York, and a large and important industry has been founded upon it. Hence it is not surprising that the Court should take the ground, amply fortified by an array of precedents, that to overthrow the patent the proof of prior knowledge and use must be "clear, convincing and beyond reasonable doubt." Notwithstanding the strength of the testimony of the defence in support of Goebel's affidavits, which is such as to constrain the Court to speak in the most respectful terms of the spirit in which the case has been conducted by the counsel for the defence, it is not difficult to perceive why the strenuous and insistent efforts of the complainant's counsel to raise a doubt in the mind of the Court, which should at least serve to prevent the refusal of the injunction, were successful. This element of doubt, in its last analysis, resolves itself into the same upon which the decision in the Beacon case is now seen to have rested, namely: the pedigree of the lamp designated as "Exhibit No. 4." However strong may be the probabilities that the story of this lamp, as given by Goebel, is substantially true, these probabilities manifestly do not fulfil the measure of certainty required by the rule of law expounded by Judge Colt and followed by Judge Seamans. If this element of doubt could have been eliminated from the history of lamp No. 4; if, for instance, it could have been identified as a lamp which had actually been burned for a reasonable period, and if it could also have been proven with sufficient certainty to have been in existence before 1879, the overthrow of the Edison patent, would, in our opinion, have been inevitable. In the face of such a showing, all other objections, however plausible, must have fallen to the ground. What the Court in effect rules, seems to be that while the defendant's testimony may be improbable, it is not necessarily unworthy of belief, merely because it is not sufficient to dispel the doubt which rests upon the authenticity from a legal standpoint of Exhibit No. 4.

The comparison which is made in the opinion between the evidence of the witnesses for the defence in this case and that which was introduced in behalf of Drawbaugh in the telephone cases, seems scarcely apropos. Not one of the numerous witnesses in that case was able to do more than to identify, in a very vague way, the general outward appearance of the instruments which he was alleged to have seen, while in the present case, the minutest details of the construction and mode of use of Goebel's lamps were related by intelligent witnesses.

The discovery of another lamp like Exhibit No. 4, with an unimpeachable pedigree running back of 1879, would at any moment put an entirely new face upon the case.

GENERAL ELECTRIC'S SITUATION.

LAST Friday and Saturday General Electric shares suffered a still further decline, touching 30 Saturday morning. Why something was not done long since to stem the tide of depreciation, by the management and the bankers known to be largely interested in the company, has been a subject of wonder, not to say surprise, on the part of observers of the market. At last something of the kind has been attempted. On Friday—when the stock touched 31½—the directors were in session nearly all day; but the result of their deliberations was not made known until after the close of business at the Stock Exchange. It was then announced that the company would pay off its entire floating debt of some $4,000,000, and that it would sell a sufficient quantity of the securities in its treasury to raise the requisite funds. The securities were offered to stockholders of the company, and it was stated that 70 per cent. of the required amount had been subscribed before the directors adjourned. It was positively announced that the dividend recently voted would be paid August 1. This seems to have quieted the rumors of an approaching receivership and to have had some part in causing a rally in the share quotations of Saturday to 38 at the close of business.

ELECTRIC RAILWAY DEPARTMENT.

FIREPROOF CAR HOUSE CONSTRUCTION.

BY

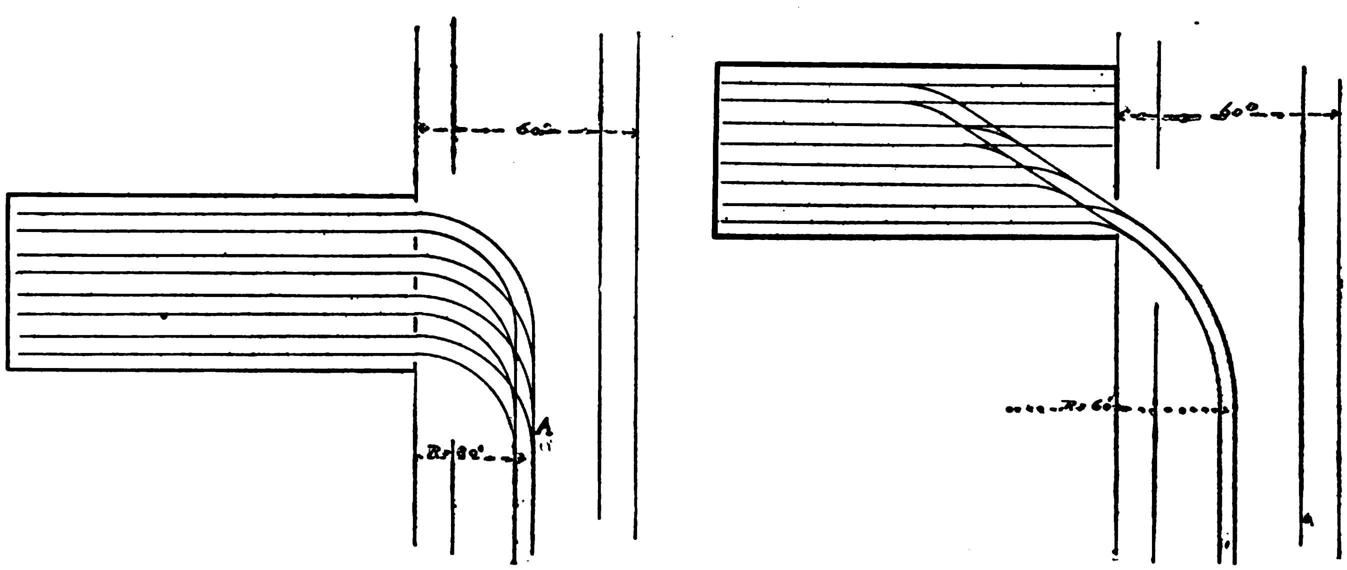
G. Langstaff Johnston

THE article and editorial in THE ENGINEER of July 5, on fireproof car house construction are of the greatest importance at this time, when we consider the great loss by fire, in the past year, of both car and power houses. I have heard it stated that the fire risks of the buildings of electric roads, contrary to what was expected, have proven much greater than those of the horse car roads. Why is this? This is the first condition of the problem that the insurance companies should endeavor to solve; then the remedy can easily be selected and applied.

Fireproof car houses can be built, and at a cost very little in excess of the unsafe structures now generally in use, and should by all means be required. If cars are not safe in a fireproof building I fail to see how any arrangement of tracks or grades, to empty it by gravity, will help matters to any great extent, for it must be remembered that the majority of the car houses are located on narrow streets and entered by sharp curves turning out from a single track in the centre of the street, and ending at the house door. If the tracks are constructed with a grade having enough to admit of the removal of the cars, it is easily seen that it would have to be an exceedingly heavy one to give them sufficient momentum to take them around the curve, and out of the way of the burning building.

In regard to a "*safe* and *legitimate* grade" to adopt, I consider for all practical purposes, the conditions are the same as those on a steam road. In railroad practice the grade on which a freight car will stand and can be moved down by the application of a slight force is called the "Grade of Repose," the rate of which is $\frac{3}{10}$ per cent., that is, 4 inches per 100 feet, or 16 feet per mile. If we admit that a grade in a car house is a desideratum, and applying the above rule, making a full allowance for all conditions, it is seen that on a grade of about $\frac{5}{10}$ per cent. cars could be moved by hand with ease and safety. If it was made a condition by the insurance company to use a grade as dangerous and excessive as three per cent., or charge an increase of rates, it would be preferable to pay the extra rate rather than put up with the many objectionable features of the heavy grade.

Fig. 1 illustrates the general plan of the majority of the car houses that are entered by curves from a main stem. It is easily seen, with this arrangement, if an attempt is made to remove all the cars at the same time, with the excitement and confusion incident to a fire, the probability is that there will be a collision at the point A where the curves join, thus blocking everything. If it could be so regulated that only one track could be worked at a time, then it is possible that good results may be had with this arrangement.



FIGS. 1 AND 2.—ELECTRIC CAR BARN TRACK CURVES.

Fig. 2 is a plan that has been only used to a very limited extent, and which admits of the house being entered by only one curve, and that with a large radius, thus reducing the curve resistance. It also possesses many other points that have proven advantageous in the transfer and arrangement of the cars. It is possible that as many cars could be gotten out with this arrangement, under the conditions that usually exist at a fire, as with any other. Grades could be put on the side-tracks falling to the diagonal track and that falling to the street.

But as I have above stated, I fail to see how any arrangement of the tracks, curves and grades is to solve the problem. Fireproof construction of the house, and proper precautions to prevent the cars from taking fire from stoves, heaters, and the trolley wires, will do it in a practical and satisfactory manner.

TROLLEY HURTS THE ELEVATED.

THE Board of Assessors of Brooklyn, have listened favorably to an argument in favor of reducing the elevated railway assessment of $200,000 a mile. The counsel who appeared for the Brooklyn and Kings County Elevated Railroads, stated that in 1891 the court said the roads should pay $170,000 a mile, which was in the opinion of the court, 70 per cent. of the valuation of the roads, namely, $245,000 per mile.

In 1892 the companies agreed to and did pay on $200,000 a mile, but this year they object to that amount on account of the inroads made by the trolley roads on their receipts. Mr. Cohen said during the last 28 days of June the Kings County road had carried 68,666 passengers less than the corresponding days of 1892, which was a loss of about 3,000 passengers a day.

During the first 13 days of July there was a shortage of 58,084 passengers as compared with the corresponding days of last year. On the Brooklyn Elevated system there had been a loss in June and July of 95,000 passengers between the Bridge and Gates avenue station alone, and corresponding losses were felt on the Myrtle avenue and other lines, due entirely, he claimed, to the disastrous competition of the trolley cars. The board gave its decision reducing the assessment.

It appears that in North New York the experience of the elevated roads and steam roads is similar, in their competition with the popular trolley lines.

ELECTRIC RAILWAY PRECAUTIONS IN NEW YORK STATE.

THE State Board of Railroad Commissioners has sent a circular to every street surface railroad in the state recommending that every car operated by the electrical trolley system in this state on a double track line be equipped with gates on both ends, and that only one gate, that opposite the other track, on the rear platform, be opened for the ingress and egress of passengers; also that no

person (except an instructor, when necessary) be allowed to ride on the platform with the motorman on an electric car. The board also recommends that on all open cars operated by the trolley system on double-tracked lines, there shall be attached a guard on the side of the car next to the opposite track, running the entire length of the car, to prevent the passengers entering or leaving the car on that side; this guard to be of such a nature that it may be transferred from one side to the other.

THE WARREN, O., AND SHARON, PA., RAILROAD PROJECT.

The franchise under which the County Commissioners have given the Warren-Sharon street railway rights of way, provides that the line must be completed to the Pennsylvania town by December 1, 1896, to Brookfield by December 1, 1895, and actual construction must be commenced by August 1, 1894. The franchise requires the filing of a bond of $25,000 as a guarantee that the rights are not sought to simply shut competitors out of the territory or for purely speculative purposes. It also prescribes the tariff of fares: Five cents from Warren to Howland; 10 cents from Warren to Vienna; 15 cents from Warren to Brookfield, and 20 cents from Warren to Sharon. The franchise also covers fares on a proposed branch from Brookfield to Youngstown, making it 25 cents by the way of Hubbard. The managers of the road will build the whole line, with the Youngstown branch, at once.

THE TROLLEY IN BROOKLYN, N. Y.

The New York State Railroad Commissioners met last week in the Brooklyn City Hall to hear the applications of the various railroad companies for permission to change their motive power from horses to the electric system. The applications are from six companies, and cover nearly 100 miles of streets. The companies have already received the consents of the local authorities.

Judge Cullen of the Supreme Court, Brooklyn, has given a judgment in the suit of the Union Railway Company against the city authorities, in which an injunction was granted because the Aldermen had given a franchise to the Union Railroad Company to construct a trolley road on Union street for nothing while ignoring the $30,000 offer of the Union Street Railway Company. He pronounced the action of the railroad committee in not entertaining this offer as "unlawful, wrong, and in bad faith, and a breach of official duty."

The Union Railroad Company has taken an appeal from Judge Cullen's decision.

SIEMENS & HALSKE RAILWAY APPARATUS IN CHICAGO.

The West and South Town Street Railway Company of Chicago has placed an order for five electric motor cars with the Pullman Car Company, which will be used on the Twenty-second street line September 1. The motors will be furnished by the Siemens-Halske Company, and are the first motors to be used in America of the German pattern. The drawings of the new motors arrived from Berlin a few days ago, and the machines are now being built it is said.

NEW CARS IN NASHVILLE, TENN.

The new cars of the Overland electric line in Nashville, Tenn., are peculiar in construction, and were designed by the president of the road. They are open at each end, with seats for eight persons on each platform, and have a closed section in the centre with 20 seats. The entire car can be thrown open when needed and all the seats face in the direction the car is going, with an aisle in the centre. The cars are 27 feet long.

ANOTHER FLY WHEEL TROUBLE AT MEMPHIS, TENN.

A special dispatch from Memphis, of July 22, says: The great driving wheel of the Memphis Electric Power House yesterday exploded into hundreds of pieces, tearing up the building and instantly killing the engineer. The wheel was four feet across, 18 feet in diameter, and weighed 2,700 pounds. It became erratic from some cause, revolving at an incredible rate of speed, and before it could be stopped, flew to pieces.

The Atlantic Avenue Road, Brooklyn, has been censured by the coroner for employing incompetent motormen and for running its cars at too high a rate of speed.

Cincinnati, O.—Owing to the landslide on Brown street, the electric line in that locality stands a chance of being absorbed—by its own roadbed.

MISCELLANEOUS.

ELI PERKINS AMAZED AT ELECTRIC POWER IN NEBRASKA.[1]

BY ELI PERKINS.

After traveling around the world I confess that I see greater surprises in my own country than even in the Orient. To-day while traveling through western Nebraska I came upon three enterprising towns—Kearney, Hastings and Gothenburg. Kearney and Gothenburg have already run the North Platte River through canals, up on the side hills, back of their towns, and Hastings has commenced to do the same thing. They are about as well off for water power as Niagara.

To-day I dropped into the new town of Gothenburg, on the Union Pacific, between Kearney and North Platte. Not far beyond is the famous Julesburg, where 30 years ago Jules Burg cut off Sandy Gammore's ears, dried them, and carried them around in his pockets. Here in this new town of Gothenburg, after looking at the splendid water power of Kearney I have been again amazed. Here on what was once a desert I see a town that can teach late inventions to Boston and Paris and set even Chicago to thinking.

"What has Gothenburg done?" you ask.

"Why, she too has run the North Platte through a 10-mile canal and made a mountain lake on the hills. The lake is 60 feet higher than the town and covers hundreds of acres. Pouring down from the lake comes a 400,000 h. p. stream of water rushing through the town."

"What has Gothenburg got?"

"She has got a central power house where turbine wheels turn electric motors, changing the Platte water into electricity and then distributing this electricity for light and power and heat over wires into every house in town. One wire turns the machinery in a brass factory recently moved to Gothenburg from Cambridge, Mass. Another wire runs into a clothing factory and turns 50 sewing machines, and another will soon run to the big flouring mill and knock out its steam engine."

"What else of Gothenburg?"

"Why, they are heating houses with this electricity from the North Platte. I saw a woman ironing with no stove in the house."

"What heats your iron?" I asked.

"This little wire hanging to the flatiron," she said. "It is heated by electricity from the North Platte."

And there I saw eggs frying in a pan on the parlor table and a coffee-pot boiling, while the bottom of it was so cool that it would not burn your hand or melt the varnish.

"Shall I make you some wheat cakes without fire?" asked a Gothenburger.

"It will take too long," I said.

"No, only a minute," he said, as he turned a button and let the electricity pass through the bottom of a griddle. Then he threw a tea cup full of flour and a spoonful of baking powder into a half pint of water, gave it a quick stir with a spoon and poured five cakes into the griddle. The little puffs and bubbles came on the cakes in a minute, and in three minutes he had the cakes steaming on my plate, and the electricity turned off again. Then he attached the wire to a broiler and an oven and broiled beefsteak and baked bread. This, mind you, was not in Paris before the academicians, but out in Gothenburg, beyond Kearney, which 20 years ago was the centre of the Great American desert. Now the farms around town and away on to Sidney are loaded with wheat; prosperity and enterprise is everywhere, and Gothenburg has given to Nebraska the most wonderful water and electric plant in the whole world. The electric plant was made by Edison; the turbine wheels came from Dayton, O.; the electric cooking apparatus came from Minneapolis, and the brains and pluck and enterprise to do this—why they are flourishing right there in Gothenburg. It seems almost like a fairy tale, but it is literally true.

TO PURIFY CROTON WATER ELECTRICALLY.

In view of the success of the experiments made by Health Commissioner Dr. Edson with Woolf's electrical purifying process, illustrated and described in The Electrical Engineer of July 19, the New York Board of Health has ordered the erection of two plants. One will be put up at Kensico Reservoir and the other at Sodom.

The two plants will have a capacity of purifying 120,000,000 gallons of water daily, and, according to Dr. Edson, will greatly tend to make the city's drinking water pure. The plants will cost about $6,000 each. It is a pity, however, that Dr. Edson could not secure a large enough appropriation to make provision for each of the three reservoirs, and thus purify the whole supply instead of two-thirds of it.

1. *N. Y. Sun.*

HUTIN AND LEBLANC ALTERNATOR WITHOUT SELF-INDUCTION.[1]

In order to avoid the use of condensers for overcoming the effects of self-induction in alternating current apparatus, MM. Hutin and Leblanc have devised a system involving the employment of a collector or commutator. The principle of the Hutin and Leblanc motor is the following: Consider a bi-polar continuous current machine, the armature of which has a number of sections $\frac{2}{n}$, and a collector with the same number of segments. The current which passes through every section of the armature changes its direction every time that the two collector segments to which they are connected pass under the brushes. All the periodic curves representing the variations of intensity will be of similar character, but they will present a difference of phase of $\frac{1}{2n}$ of a period when passing from one section to the following. All this is independent of the position of the brushes, or, in other words, of the algebraic sum at any one instant of the electromotive forces of all the sections in the series between the two brushes. This being given, suppose the circuit of every

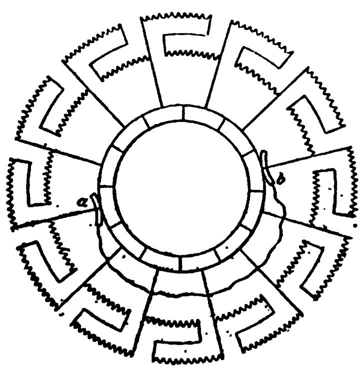
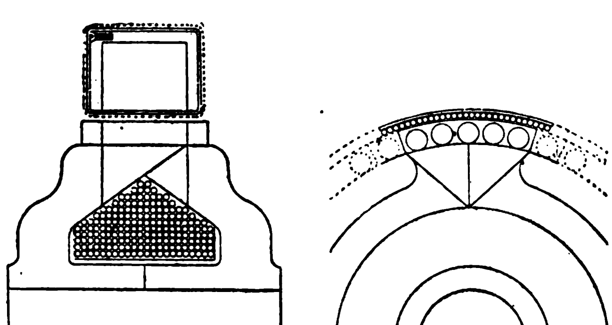


FIG. 1.

section of the armature is prolonged outside the machine, so as to take in an external circuit, as shown in Fig. 1, where the machine is assumed to have twelve sections. With this arrangement the external circuits are traversed by the same current as the sections on the armature, and in the case assumed, the different currents are shifted $\frac{1}{12}$ of a period behind each other for each revolution. If the circuits were the seat of periodic E. M. F.'s, having a frequency of $\frac{1}{T}$ of equal amplitude, and presenting a difference of phase of $\frac{1}{2n}$ of a period, the introduction of these E. M. F.'s would be balanced simply by changing the position of the brushes, the machine acting like a generator to furnish a continuous current and the apparant self-induction of the system would be zero. The machine in which this principle is carried out in an alternator is shown in Figs. 2 to 7, Figs. 2 and 3 being sections parallel and at right angles to the axis of the machine.

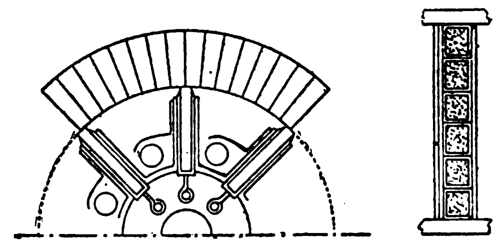
The armature consists of a Gramme ring which is stationary.



FIGS. 2 AND 3.

The inducing field magnets move inside of this ring, and are excited by a single coil concentric with the shaft of the machine. The core of this coil carries polar projections which alternate with each other, and all brought close to the Gramme ring, so as to form a series of alternative, positive and negative poles, as shown in Fig. 3. The ends of the pole pieces are pierced by holes parallel to the axle and through it copper rods are threaded, the ends of which are rivetted to two bronze rings. The collector or commutator is fixed and the brushes revolve, as illustrated in Figs. 4 and 5.

If the machine operates as a generator and is excited by an

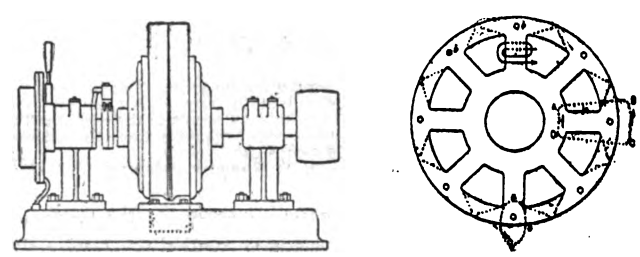


FIGS. 4 AND 5.

independent source the brushes are connected among one another, but if employed as a motor the excitation would have to be furnished by current passing from one brush to the other, the brushes being insulated from one another which current would be continuous when the machine has reached synchronism. Fig. 6 shows the complete machine which in order to act as a motor must be operated synchronously with the generator in order to allow the machine to come up to synchronous speed.

The inventors have employed an armature, illustrated in Fig. 7, built up of laminated sheets. The star-shaped branches are wound with coils as indicated diagrammatically, and the coils are connected so as to obtain, at the extremity of the branches, a series of north and south poles. The outer ends of the branches are perforated and through the holes so formed *b b*, insulated copper rods are threaded, which are connected to two bronze rings which also serve to press the armature plates together; by this arrangement the machine can be brought up to speed from rest.

The type of machine here illustrated can be used without modification, on single phase alternating current circuits when used in connection with the Hutin and Leblanc transformer. In the latter an ordinary single phase alternating current is, as it were, broken



FIGS. 6 AND 7.

up into $2n$ alternating currents of the same frequency, with a difference of phase between each equal to $\frac{1}{2n}$ of a period. This arrangement can be reversed so that a polyphase current put into the transformer will operate the motor.

1. *La Lumière Electrique.*

ELECTRICITY ON THE CANALS.

MR. A. H. COWLES, of the Cowles Aluminum Company, in a recent interview on the subject of using electricity on the canals, said:

"There seems in my mind to be no serious obstacles in the way of providing the electrical power. At stated intervals along the canal there are places where water power is either available or can be made so and at these places power houses can be constructed and the electricity generated at a very low figure. Take it at Lockport, for instance. A big power can be secured there which would virtually cost the State almost nothing. In fact, the canal seems to be endowed with these natural advantages which will make the project very easy of accomplishment.

"Another thing, I think that electricity applied to the canal would do away with that chronic complaint of the boatmen at Lockport of the current being so strong that they cannot move their boats up to Tonawanda against it owing to the amount of water taken out by the manufacturers. An electric motor boat would not mind a little thing like that and with plenty of power would slide along without opposition."

"What is your idea about using the tow-path for electric cars, Mr. Cowles?"

"Yes, that is another departure which I think could be made to pay. There is no reason why every city and town along this

great water way could not be linked together by an electric railroad run with the same current which operates the canal boats. As to whether the State should control this I cannot say. However, I am in favor of the State, if possible, controlling it or at least leasing the rights to operate such a road. The possibilities in this direction I consider quiet gigantic in their nature."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 11, 1893.

Alarms and Signals:—

Letter Box, Peter J. Fitzgerald, Hyde Park, Mass., 501,270. Filed Oct. 13, 1890.
An alarm mail box.

Electric Bell, Wilson J. Newman, Brooklyn, N. Y., 501,292. Filed Oct. 28, 1892.

Electric Alarm Money Drawer, William J. Walker and Alexander L. Bedford, St. Louis, Mo., 501,306. Filed April 12, 1893.

Batteries, Primary:—

Electric Battery, James H. Mason, Brooklyn, N. Y., 501,151. Filed Nov. 14, 1892.
A two-fluid battery with horizontal division.

Distribution:—

Equilizer for Rotary Current System, P. Nordmann, Berlin, Germany, 501,094. Filed Feb. 23, 1893.
For use with a multiphase current system of distribution.

Dynamos and Motors:—

Commutator Connection, Norman C. Bassett, Lynn, Mass., 501,049. Filed Feb. 9, 1893.

Regulator for Dynamo-Electric Machines, William H. Elkins, Cambridge, Mass., 501,059. Filed June 23, 1892.
Especially adapted to machines arranged to feed two separate circuits from the same commutator.

Brush for Dynamo Electric Machines and Motors, Jonathan P. B. Fiske, Lynn, Mass., 501,060. Filed Jan. 31, 1893.
For direct current machines.

Dynamo Electric Machine, Harry L. Tyler, Corning, N. Y., 501,117. Filed Oct. 17, 1892.
Relates to details of construction. Employs a stationary armature and revolving fields inside.

Commutator Brush Holder, Alton J. Shaw, Muskegon, Mich., 501,193. Filed Feb. 17, 1893.

Revolving Armature for Electric Machines, Elmer A. Sperry, Chicago, Ill., 501,194. Filed Jan. 8, 1892.
Details of construction.

Method of Regulating Dynamo Electric Machines, Merle J. Wightman and Hermann Lemp, Hartford, Conn., 501,309. Filed Feb. 13, 1886.
Claim 1 follows:
The herein described method of regulating the action of a dynamo electric machine or motor, consisting in determining by any desired means the relative potentials at the terminals of a branch connected to the circuit containing a field magnet coil or portion of coil at opposite sides of said coils respectively, irrespective of the resistance of said branch.

Armature, Joseph J. Smith and Geo. W. Findlater, Jamaica, N. Y., 501,376. Filed May 26, 1892.
Details of construction.

Revolving Motor, Herbert L. Parker and Alexander W. Meston, St. Louis, Mo., 501,482. Filed Oct. 22, 1892.
Especially adapted for fans. Motor may be adjusted to revolve while in operation or to remain stationary.

Lamps and Appurtenances:—

Electric Arc Lamp, J. Jergle, Vienna, Austria-Hungary, 501,074. Filed Nov. 25, 1891.
A friction coupling for the carbon feed mechanism.

Electric Arc Lamp, G. Kirkegaard, Brooklyn, N. Y., 501,080. Filed Nov. 12, 1892.
Relates particularly to the carbon holder.

Electric Arc Lamp, Geo. Kirkegaard, Brooklyn, N. Y., 501,081. Filed Feb 20, 1893.
Relates to carbon holder and automatic cut-out.

Electric Lighting System, P. Nordmann, Berlin, Germany, 501,095. Filed Nov. 18, 1892.
Automatic regulation of the potential in a multiple-wire system.

Duplex Electric Arc Lamp, Chas. E. Scribner, Chicago, Ill., 501,170. Filed Oct. 27, 1890.
Consists of two distinct lamps mounted together.
Claim 1 follows:
The combination with two arc lamps in series in the same circuit, of contact points controlled by the lifting mechanism of one of the lamps to be closed together when the same is energized, and a shunt or by-path about the other lamp including the said contact points, whereby one of the lamps is short circuited during the operation of the other.

Manufacture of Incandescent Electric Lamps, Elihu Thomson, Swampscott, Mass., 501,172. Filed Aug. 5, 1892.
Claim 1 follows:
An apparatus for expelling residual air from incandescent lamp bulbs, which consists of a box having a lid adapted to support the lamps and a furnace for heating the contents of the box to the desired high temperature.

Electric Signaling Circuit, Wm. Daves, Jersey City, N. J., 501,183. Filed May 2, 1892.
Adapted to control the admission of current to a series or group of lamps.

Socket for Incandescent Lamps, Ekel Ekström, Lynn, Mass., 501,205. Filed June 27, 1892.

Electric Contact Apparatus, Jonathan P. B. Fiske, Lynn, Mass., 501,206. Filed Aug. 12, 1891
A switch for light and power circuits.

Measurement:—

Ammeter, Wm. Hochhausen, Brooklyn, N. Y., 501,104. Filed Feb. 28, 1891.
A voltmeter or ammeter, indicating also the polarity of the current.

Miscellaneous:—

Electric Switch, Carl Friedrich Wilhelm Höfer, Berlin, Germany, 501,071. Filed March 25, 1893.

Switch for Electric Conductors, Olaf Offrell, Middletown, Conn., 501,191. Filed Aug. 12, 1892.
A snap switch.

Electric Switch, Frederick A. Thum, Newark, N. J., 501,173. Filed March 14, 1893.

Lightning Arrester, E. Thomson, Lynn, Mass., 501,114. Filed June 20, 1890.
Claim follows:
In a lightning arrester, the combination of the line conductor with a tubular, sheet-like discharge conductor connected to ground and surrounding the line conductor, and the self-induction coil between the apparatus to be protected and the point of connection between the line conductor and tube.

Electric Snap Switch, Caryl D. Haskins, Lynn, Mass., 501,066. Filed Jan. 24, 1893.
For electric light circuits.

Automatic Circuit Interrupter, Alexander Wurts, Pittsburgh, Pa., 501,201. Filed Oct. 5, 1892.
For interrupting a circuit automatically on the occurrence of an abnormally strong current.

Lightning Arrester, James E. Browne, Elizabeth, N. J., 501,241. Filed Sept. 12, 1892.

Electric Time Switch, James F. McLaughlin, Philadelphia, Pa., 501,291. Filed Sept. 29, 1892.
For automatic operation at predetermined times.

Junction Box, William Brooks Sayers, Glasgow, Scotland, 501,445. Filed June 16, 1892.
For concentric and other conductors or fittings for electric circuits.

Electric Switch, Lucius T. Stanley, Brooklyn, N. Y., 501,450. Filed March 27, 1893.
Operated by the opening and closing of a door.

Railways and Appliances:—

Electric Signaling-Circuit, W. Daves, Jersey City, N. J., 501,183. Filed May 2, 1892.
Adapted to railway service.

Electric Locomotive, Elmer A. Sperry, Chicago, Ill., 501,195. Filed April 29, 1892.
Relates to gearing and the elastic support of the motor.

Electric Locomotive, Wm. E. C. Eustis, Milton, Mass., 501,246. Filed Nov. 5, 1891.
Employs an auxiliary generator upon the axle with the motor for control in stopping and starting.

Electric Circuit Closing Device, Wm. Sears, Boston, Mass., 501,258. Filed April 10, 1893.
For indicating the names of streets in a car as they are approached.

Railway Signal, James Wayland, Newark, N. J., 501,307 Filed Jan. 21, 1893.

Railroad Crossing Alarm or Signal, Elwood O. Potter, Vineland, N. J., 501,438. Filed April 6, 1891.

Trolley Wire Hanger, Alexander W. Meston, St. Louis, Mo., 501,481. Filed Oct. 31, 1892.

Telephones and Apparatus:—

Telephone Circuit and Apparatus, S. J. Larned, Evanston, Ill., and F. A. Pickernell, Newark, N. J., 501,085. Filed March 20, 1893.
Relates to exchange systems in which a series of stations are served by a smaller number of main circuits which latter are common to and accessible by all stations.

Station Apparatus for Telephone Circuits, S. J. Larned, Evanston, Ill., and F. A. Pickernell, Newark, N. J., 501,086. Filed March 20, 1893.
Amplification of the next above.

Electric Signaling, T. D. Lockward, Melrose, Mass., and Sherwood J. Larned, Evanston, Ill., 501,087. Filed March 27, 1893.
For a telephone exchange service of the class referred to above. Provides circuit arrangements for calling any sub-station without notifying any other in the same group.

Telephone Signaling Apparatus and Circuit, F. A. Pickernell, Newark, N. J., 501,102. Filed March 20, 1893.
Amplification of the system shown in No. 501,085, above.

Telephone Switch, Chas. E. Scribner, Chicago, Ill., 501,168. Filed Dec. 27, 1886.

Telephone Exchange Apparatus, Chas. E. Scribner, Chicago, Ill., 501,169. Filed June 6, 1888.
For use on a metallic circuit including several subscribers' stations.

Visible Signal, Francis W. Dunbar, New York, N. Y., 501,185. Filed May 4, 1893.
An automatically restoring anunciator, specially adapted to telephone service.

Support for Telephonic Receivers, Norval L. Burchell, Washington, D. C., and Burnet L. Nevius, Jr., Washington, D. C., 501405. Filed Nov. 3, 1892.

Station Apparatus for Telephonic and Telegraphic Circuits, Theodore Spencer, Cambridge, Mass., 501,473. Filed Feb. 20, 1893.
For the elimination of side tones or undesired signals.

COLLEGE NOTES.

AN ELECTROTHERAPEUTIC COURSE OF LECTURES.

A STRONG tide of progress in electrotherapeutics has set in during the last two years in this country, and many medical men of acknowledged standing have become so convinced of the importance of electricity in the medicine of the future that they have undertaken a course of special study in the subject, and so been enabled to place themselves abreast of the newest and most approved practice. Many practitioners, however, are unable to avail themselves of the regular post-graduate college course, and will gladly welcome such an opportunity for tuition as is afforded by the private clinic of Dr. Robert Newman, in this city. After many solicitations from practitioners to give private lectures in electrotherapeutics, and particularly in surgical electrolysis, Dr. Newman decided to give such a course. The instruction is given in the same manner as that in post-graduate colleges, except that it is private, and limited strictly to a small number of students. The course consists of 12 lectures, in which clinical instruction is predominant, the modus operandi of all operations being shown. The past course has been eminently successful, and the class for the next course, which will begin on November 1, is already made up. Dr. Newman has been called "the father of medical electrolysis," and his labors in this field for the last quarter of a century

have been abundantly recognized. He has designed many of the most effective electrodes, now in use, and has contributed in a marked degree to the placing of electrolytic practice in medicine on its modern basis. Dr. Newman has been invited to deliver clinical lectures in electrolysis in Chicago, by the Post-Graduate Medical School during the course beginning September 1.

COLUMBIA COLLEGE.

AT the last commencement, the degree of Electrical Engineer was given to Milton Church Canfield, Frederick Malling Pederson and Francis George Robinson.

LEGAL NOTES.

EDISON LAMP LITIGATION IN NEW YORK.

Two suits were begun on July 27 in the United States Circuit Court for the Southern District of New York by the Edison Electric Illuminating Company, of New York, on the Edison incandescent lamp patent, one being against the Mount Morris Electric Light Company, Edward May and Julius A. May, and the other against the United Electric Light and Power Company, Caleb H. Jackson, Herman H. Westinghouse and George Westinghouse, Jr. Injunctions and accountings of profits are asked for, and the hearing will be had before Judge Lacombe August 2. It will be remembered that similar suits were brought recently against users operating isolated plants in New York city, and that injunctions were granted.

RESTRAINING THE BUCKEYE AND PACKARD LAMP COMPANIES.

THE GENERAL ELECTRIC COMPANY has secured restraining orders from Judge Ricks of the United States Circuit Court for the Northern District of Ohio, under the Edison lamp patent, against the Buckeye Electric Company, and the Packard Electric Lamp Company of Ohio, manufacturers of incandescent lamps.

EDISON PHONOGRAPH PATENT LITIGATION.

NEWS comes from Washington, D. C., that the Edison Phonograph Company has, through Messrs. Mackall and Maedel, filed a bill against the American Graphophone Company, Samuel M. Bryan and E. D. Easton, for an injunction, an accounting, etc. It is claimed that the graphophone is an infringement on the Edison patent for the phonograph, and that the Edison Company has the sole right to operate the patent in that district.

PATENT NOTES.

MORE STORAGE BATTERY LITIGATION IN SIGHT.

As our readers are aware, The Metropolitan Railway Company of Washington, D. C., for some time past has been operating a number of its cars with storage batteries. In order to determine the battery best adapted for its purposes the company has not confined itself to a single type of cell, but has had a number of various makes on trial, among them those of the Laurent-Cely or "Chloride" type manufactured by the Electric Storage Battery Company, of Philadelphia.

Last February Mr. Wm. Bracken, president of the Consolidated Storage Battery Company, addressed a letter to Mr. Geo. W. Pearson, president of the Metropolitan Railway Company, in which he informed the latter that he considered the Chloride accumulator used on the Metropolitan Railway a clear infringement of the Brush patent controlled by the Consolidated Company. On July 24, after the decision by Judge Coxe, declaring the Faure patent to have expired by limitation, Mr. Bracken addressed another note to Mr. Pearson, calling his attention to this decision and informing him of the intention of his company to bring suit for infringement, and warning Mr. Pearson against further purchases of cells from the Electric Storage Battery Company.

As was to be expected Mr. Pearson turned the entire correspondence over to the Electric Storage Battery Company, and the latter have not been slow to announce the position they propose to assume in the future.

In a letter addressed to Mr. Bracken, dated July 27, 1893, and signed by Mr. W. W. Gibbs, president of the Electric Storage Battery Company, that gentleman denies that the cell manufactured by his company infringes the Brush patent in the slightest degree, and challenges Mr. Bracken's authority for the statement to that effect made by him in his letter to Mr. Pearson. Mr. Gibbs, being advised by counsel and experts, also informs Mr. Bracken that his company will protect all users of its cells.

In order, however, to bring the points at issue between them to as speedy a determination as possible, Mr. Gibbs formally invites Mr. Bracken to bring suit and to apply for an injunction, and to facilitate the carrying out of such proceedings offers to sell the Consolidated Storage Company's cells manufactured by the Electric Storage Battery Company, and to give the company in addition a sworn statement of precisely how the cells are made, with permission to use the same in any proceedings against them. In order to avoid delay they have authorized their counsel, Mr. John R. Bennett, of New York, to accept service of papers in their name and to aid the Consolidated Company in every possible way to reach the courts at the earliest possible moment.

Mr. Gibbs adds that if the Consolidated Company has confidence in its position it will proceed against the Electric Storage Battery Co., at once, failing in which, however, the latter company declares its intention to proceed against the Consolidated Company to protect its interest and to hold Mr. Bracken's company responsible for damages resulting from the statements and letters such as those sent to Mr. Pearson in Washington.

Dr. Charles F. Chandler who was engaged as expert in the litigation between the Brush Electric Company, the Julien Electric Company, and the Electrical Accumulator Company, has recently made a report on the "Chloride Accumulator" of the Electric Storage Battery Company, in which, after describing the method of manufacture and quoting the opinion of Judge Shipman of the Circuit Court of Appeals upholding the Brush claims, he concludes as follows:

"I am therefore of the opinion that your battery does not either in itself, in the process by which it is manufactured, or in its use infringe the claims of the Brush patents. I am familiar with all the batteries that have been held to infringe the Brush patents, and in all of them the distinguishing features of the Brush invention as set forth in the quoted passages of the opinion of the Court of Appeals were clearly present. No battery such as yours, has been held to be an infringement of the Brush patent, and from my understanding of the opinion of the court of last resort, the Circuit Court of Appeals, such conclusion would be impossible."

ELECTRO-MORPHINE GERRYCIDE.

THE last "electrical" execution was even more of a grim and ghastly failure than any that have preceded it. A negro murderer was put into the chair at Auburn, N. Y., prison on July 27, but the dynamo broke down at the first contact, leaving the man alive, and the second contact was not made until an hour later. In the interval the doctors kept the prisoner plied with morphine and chloroform. The second contact current was furnished from the Auburn street circuits, and for aught one can learn to the contrary was not an alternating but an arc current. That finished the man, and it ought to finish the infernal outrages of electrical gerrycide.

M. VIOLLE ON THE LIGHT OF THE ELECTRIC ARC.

AT a meeting of the International Society of Electricians, on the 7th inst., M. Violle described the experiments which he had been making on the electric arc. This experimenter has found that the light intensity of the positive carbon remains sensibly constant when the power supplied is varied in the proportion of 1 to 60. He has employed two methods of measurement: that of the spectrophotometer, the accuracy of which is really much greater than is usually stated to be the case; and a second method due to Arago, employing interference fringes. M. Violle exhibited a number of photographs of arcs of different candle-power, in order to show the constancy of the intensity of the positive carbon. By measuring the opacity of the negative plates, these photographs could be used as a gauge of the intensity. M. Violle recalled that this phenomenon had already been investigated by Rosetti, as well as by Capt. Abney and Silvanus Thompson; and everyone had attributed it to vaporization of the carbon. This opinion was perfectly justified, for the deposit on the negative carbon has the appearance of having been condensed from vapor, and M. Violle had actually been able to produce crystals on this part. A photograph of an arc produced between carbons of purified retort carbon was next shown, and this exhibited a very curious appearance. Despretz had also observed that the phenomenon was due to volatilization, but that there was fusion or more or less softening of the carbon; he had also attributed the deposit of carbon, which is formed in the arc, to the condensation of vapor of carbon, but he was unable to elucidate the question because he used impure carbons. M. Blondel has recently recognized that impurities in the carbon have not, in practice, any sensible effect on the intensity, which remains constant with carbons of very different quality. The intensity of the arc, he thought, was therefore a constant, and it might be utilized as such. M. Violle stated, in conclusion, that the temperature of 3,500° C., which is given for the arc, ought to be considered as a provisional value, although the true temperature is probably but little different from this figure.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE HERCULES ARC LIGHT CUT-OUT.

THE UTICA ELECTRIC MANUFACTURING AND SUPPLY COMPANY, of Utica, N. Y., received the following this spring from the World's Fair authorities:

We are in receipt of sample Hercules No. 1 Arc Light Cut-Out and beg to inform you that we have given the same a thorough test, which has proved very satisfactory. This switch was tested by first cutting in 40 lamps, then 50, and finally cutting in 70 lights. The switch operated very satisfactorily up to 50 lights, without any trouble whatever. Up to 70 lights, however, we found it necessary to throw the handle over as rapidly as possible. With this little extra exertion, the switch operated very successfully, and I can congratulate you upon its operation. We yesterday sent you a telegram as follows: "Sample satisfactory; ship Hercules Cut-Outs, ordered with glass covers, immediately."

NEW CATALOGUE "T" OF QUEEN & CO., INCORPORATED.

THIS Philadelphia company has just issued a fourth edition of its Electrical Apparatus Catalogue, which illustrates very forcibly the enterprise of American manufacturers in producing high grade instruments to compete with "all comers." Printed upon excellent paper, the well executed cuts produce a pleasing effect, while the descriptive matter is clear and concise. A number of new standard instruments, designed in the Queen laboratory, are shown for the first time, and are sure to attract deserved notice from college professors and electrical engineers throughout the country. Examples of all the important pieces are exhibited by the company at the World's Fair.

THE WORLD'S FAIR "FLYER."

THE "Exposition Flyer" is what the New York Central call their 20-hour train between New York and Chicago. The distance between these two cities is very nearly 1,000 miles, and a train must needs be a "flyer" to make the trip in the time named. This train leaves New York at noon, and is not overtaken by darkness until Syracuse has been left behind, the beautiful Hudson River and Mohawk Valley being passed in daylight. The rising sun sheds its rays upon the "flyer" just a little west of Cleveland, Ohio, where the road skirts the shores of Lake Erie. The many scenic delights of this route, as well as the magnificent train service, induce many World's Fair visitors to go via New York city. —*Dixie*.

A BIG PAY ROLL.

IT is stated by the Lynn papers that the pay roll for the week ending July 21, for the General Electric Co.'s factories in that city, was $51,000, and was the largest ever made out and cashed by that concern there.

ARCHER & PANCOAST MANUFACTURING COMPANY.

A REPORT of the condition of the Archer & Pancoast Manufacturing Co., gas fixtures, of 900 Broadway, has been prepared by William A. Harding, accountant, and printed for distribution among the creditors of the concern. The total liabilities are $1,109,458, of which $216,725 are contingent. The total nominal assets are $1,570,666; actual assets, approximated, $1,141,691. The committee of creditors, it is said, reports that the receivers have reduced the expenses of carrying on the business at least $45,000 a year, and recommends that it is in the interest of the creditors that the business should suffer no interruption whatever, in order that the good will of the company may be preserved to its fullest value for the creditors.

NEW YORK NOTES.

MR. L. W. WASHINGTON, manager of the Supply Manufacturing Co. of Pittsburgh, Pa., was in New York last week for a few days, making a general Eastern business trip. He reports that his company have taken up a new line of trade in connection with their already well-known manufacture of commutators. The new venture consists of the buying of old street car motors, the rewinding of armature and field coils and furnishing of a new commutator. This ensures practically a new machine, which may be sold at a considerably lower price than the motor fresh from the manufacturer. Mr. Washington's former connection with the Westinghouse Company fits him to take charge of this branch of the Supply Manufacturing Company's department, and he tells of some good sales already made.

THE STERLING CO., through their general sales agent, Mr. F. A. Scheffler, 74 Cortlandt street, inform us that they have made the following handsome sales during the past week: Minneapolis Electric Co., 750 h. p.; J. C. Mattingly, Louisville, Ky., second order, 750 h. p.; Taylor Chair Co., Bedford, O., 150 h. p.

THE CLAMP SOCKET MANUFACTURING COMPANY, of 39 and 41 Cortlandt street, New York, have changed their name to the Newton Electric Company, and have enlarged their field of operations. They will now make fixture and cord sockets and general electrical appliances including switches, cut-outs, etc.

BELMAR, N. J.—Chancellor McGill of New Jersey has denied the application of the Avon Land and Improvement Company for an injunction restraining the Asbury Park and Belmar Electric Railway Company from operating its road through Avon. The land company will certiorari the case to the Supreme Court.

THE GOODYEAR HARD RUBBER CO. and the India Rubber Comb Co., agents for Chicago Electric Wire Co., have received a contract from the U. S. Government for 50 miles of submarine cable to be used by the U. S. Engineering Corps at Willets Point for torpedo service.

HUDSON, N. Y.—E. G. Bernard Company have taken a contract to install a plant of 300 lights in the House of Refuge. The plant will be first-class in every respect.

NEW ENGLAND NOTES.

THE MASON REGULATOR COMPANY have issued a very interesting and pretty "old time" circular in red and blue relative to their enlarged factory and the products made there.

WESTERN NOTES.

FAN MOTOR TRADE.—The recent spell of hot weather has stimulated the fan motor trade and, as usual, the Ansonia Electric Company report that they have been unable to supply the demand although their stock was unusually large. They make a specialty of fan motor outfits operated by batteries and their sales of these have far exceeded their expectations. They are handling that "old stand by," the Edison motor operated by Edison-Lalande batteries, and as they have just received a fresh stock, they will again be able to fill orders promptly for both the No. 1 and No. 2 sizes.

THE ELECTRIC APPLIANCE COMPANY report that the demand for the "Swinging Ball" lightning arrester continues as brisk as ever although the season is now well advanced. These arresters are coming into such general use that it is a very common sight to see a line of poles having a black cone-shaped box scattered at intervals along the line, say on every fifth or tenth pole, according to local conditions; and in reply to the questions that usually arise, the seeker for information is told that the boxes are swinging ball lightning arresters. Under ordinary conditions a proper equipment is about 10 or 12 to a circuit.

THE ELECTRIC APPLIANCE COMPANY report that it is very interesting to note the way in which the orders commence to pour in for Meston fan motors after a few consecutive hot days. They have already sold several hundred of these machines and are filling large orders every day for country as well as city trade. A very large number are now in use at the Fair, and the Electric Appliance Company expect to have several hundred motors installed there before the fan season is over.

THE ANSONIA ELECTRIC CO., have recently shipped a number of "W. W." lightning arresters to the oldest and largest electric manufacturing company in Germany, who carefully investigated arresters before placing the order.

MR. ALEX. Dow has been appointed city electrician of Detroit, where a municipal plant is under consideration. The salary is $3,000 per annum.

ST. LOUIS NOTES.

THE ST. LOUIS ELECTRICAL SUPPLY COMPANY, general agents for the Muncie Electrical Works, Muncie, Ind., have just closed a contract with the St. Louis Exposition and Music Hall Association for two 500-light Muncie dynamos. These machines will be used for the exhibit lighting during the Exposition. The Muncie Electrical Works are fortunate to place two of their machines in such a prominent place, where they will be seen by so many visitors from throughout the southwest, and will spare no expense in the effort to make the apparatus the finest and best finished that has ever been seen in St. Louis.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

Vol. XVI. AUGUST 9, 1893. No. 275.

THE ELECTRIC PORTAGE BETWEEN LAKES ONTARIO AND ERIE.

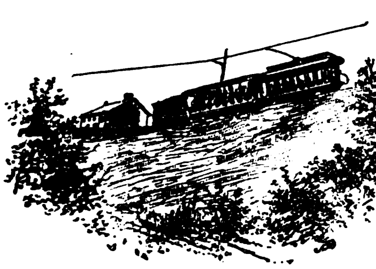
BY

T. C. Martin

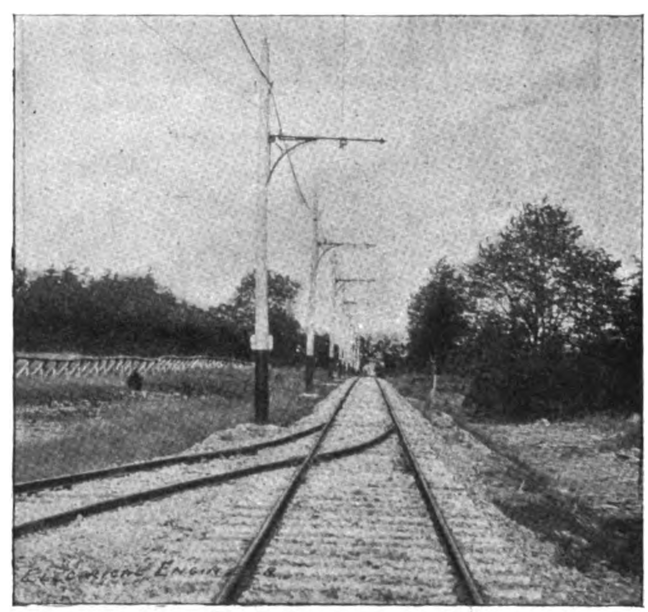
I.

CANADA has been quicker than any other part of the British Empire, not excepting the mother country, to appreciate and adopt the electric railway. As far back as 1884, the encouragement given him in the Dominion induced the late Charles J. Van Depoele, a pioneer if ever there was one, to construct a road at Toronto, running out to the Exposition, with conduit contacts; while his road with overhead conductors, in the same city, in 1885, over practically the same route, carried as many as 10,000 passengers a day. Then came the Van Depoele roads at Windsor, Ont., and St. Catharines, Ont., both successful, and the latter to this day using its old platform motors with sprocket wheel connections to the axle, and metallic circuits with overrunning trolleys. When we turn to the roads now in operation and especially to the magnificent road lately equipped and started by Canadian capital and enterprise at Niagara Falls, we realize how crude and faulty the early work was. But without it, the art would not have attained its present perfection, nor should we with such hopeful examples as the Niagara road before us be looking forward to the immediate employment of electricity for tractive purposes on long roads to whose operation steam alone has hitherto been considered adequate.

It is true that in her noble water powers, Canada possesses a strong inducement to the transmission and utilization of their energy by means of electricity, but the fact that they had all the resistless Niagara River to draw upon did not save the projectors of the Niagara Falls Park & River Railway Company from a good deal of ridicule and sarcastic comment when their scheme was first brought forward. This scheme was to build a first-class electric trolley road from Queenston, the head of navigation on Lake Ontario, around the Falls and the Rapids, to Chippewa, the foot of navigation on Lake Erie, a distance of about 13 miles. These termini are at this hour, and have been these 50 years, ruined and deserted communities, left aside by the stream of travel flowing in newer channels; and to many people it seemed a wellnigh crazy project to build a road over the ancient "portage" between the two hamlets, and to trust for an income to the chance fares of visitors to the intervening Falls. Despite opposition and criticism, however, the plan was carried out, and its success is a standing monument to farsighted enterprise and to engineering skill. Every Canadian who travels over the road is proud to know that it has been built by Dominion capital and is operated by his countrymen; that the equipment is practically Canadian throughout, and that the road is not excelled in any respect in either the United States or Europe. So marked is the success of the road, and so obvious now are its possibilities, that ridicule has changed into all kinds of hints as to the ulterior motives of its incorporators, and as to its value as a link between the large railway systems converging at Suspension Bridge. It is an old story. Nothing is more foolish than failure; nothing more astute than success.



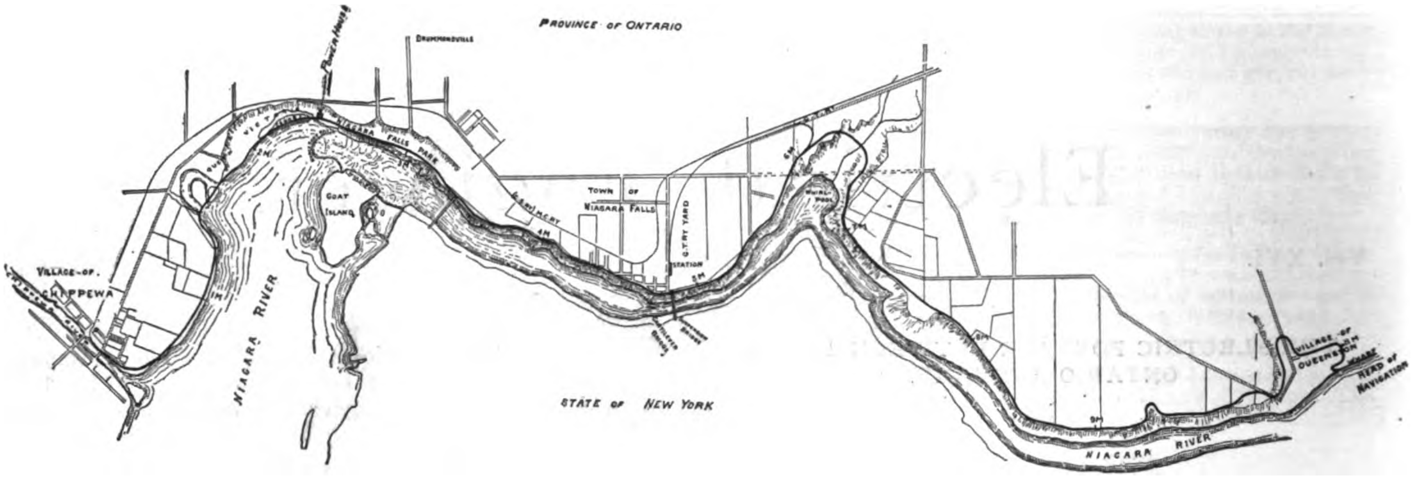
Up the Queenston Grade.



A STRETCH OF TRACK BETWEEN THE WHIRLPOOL AND QUEENSTON.

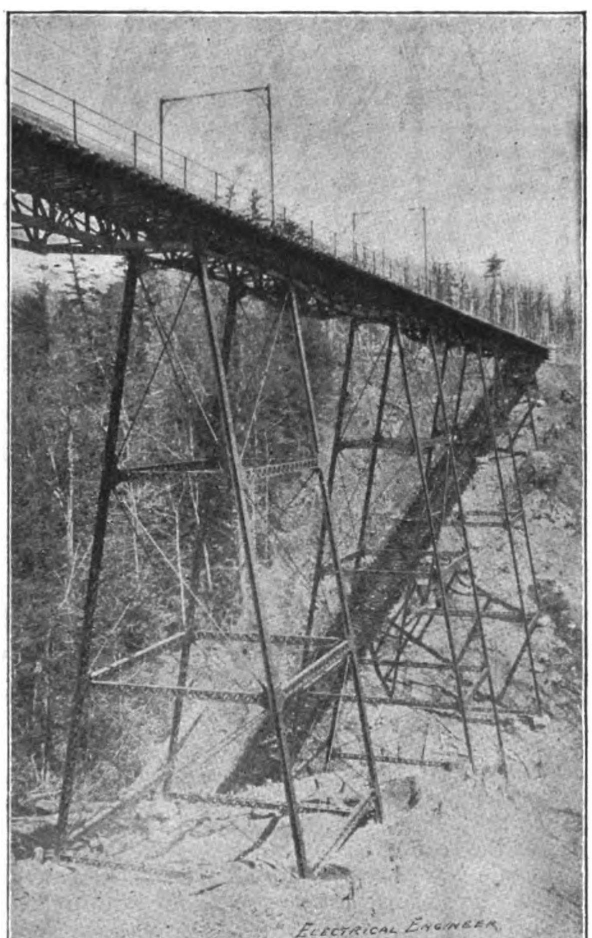
II.

The road may be said to begin at Queenston, where it connects with the dock of the Niagara Navigation Co., whose fine line of steamers ply across Lake Ontario to Toronto, about 40 miles below. The plan of the road shows how it runs from this point to the northern end at Chippewa above; and the profile given affords a good idea of the grades. The road has no less than 37 per cent. of

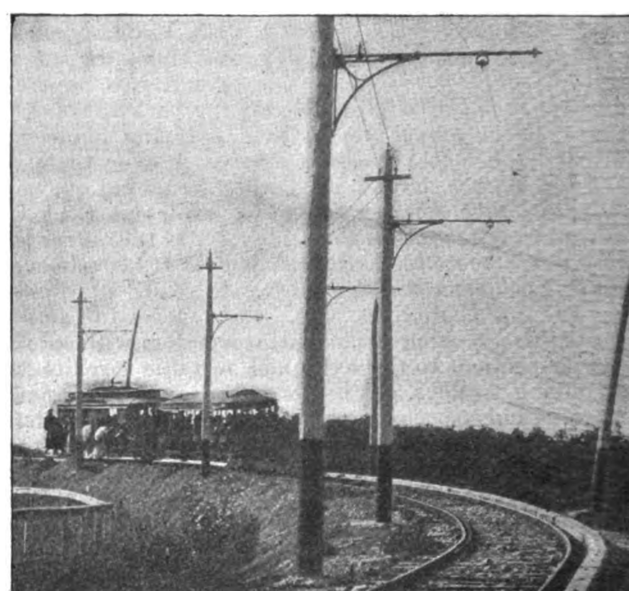


PLAN OF THE LINE OF ROAD.

curve, but the grades are not much to speak of except at the Queenston end, where five per cent. is encountered in climbing the bluff crowned by the Brock column that memorizes the stirring events of the War of 1812. Drowsy Queenston once left behind, the road follows faithfully every winding of the Niagara River, whose original survey has been cleverly adhered to by Mr. W. T. Jennings, C. E., with the object of permitting the visitor to see the rushing waters from every possible point of view. As a matter of fact, the road runs on government property a very considerable portion of its length, and a sum of not less than $10,000 per annum is paid for this privilege, which enables the track to be never more than 60 feet from the edge of the cliff. The first thing that strikes an observer is the British solidity and massiveness of the construction. It is regular steam railroad work, and a little more. The track is built with standard 56 lb. steel C. P. R. rail, with angle fish plates, on 8 by 6-inch cedar and tamarack ties spaced from 2 to 2 feet 6 inches apart. The gauge is 4 feet 8½ inches. The track is ballasted with 18 inches of broken rock, obtained from quarries along the line, and carefully tamped down. Over this track the cars roll as smoothly as balls on a billiard table. In order to ascertain what could be done on it, a run was made last week from end to end, when the 11½ miles, with one stop, were covered in just over 29 minutes—a speed of 24 miles an hour. The overhead construction is equally substantial. As shown on the profile, the road is in all 60,040 feet long. Of this distance, that part between stations 92 and 180 is equipped with tubular steel poles of 6, 5 and 4 inch sections. The drawing shows the pole with hood and bracket. The remainder of the line is equipped with 7-inch top cedar poles, the base painted green and the tops white. The maximum distance between poles is 100 feet. In many cases, on curves, and where the feeders are heavy, near the power house, this distance is reduced to 50 and 40 feet. All the steel poles are set in concrete and the wooden poles are set with a concrete footing and 12 inches of concrete around the base.



THE TRESTLE OVER BOWMAN'S RAVINE.



LOOKING AT THE WHIRLPOOL, 250 FEET BELOW, ON THE RIGHT.

The work of construction, in a stern Canadian winter, was not child's play. When it began during the fierce storms of last January, the heavy snows crusted with

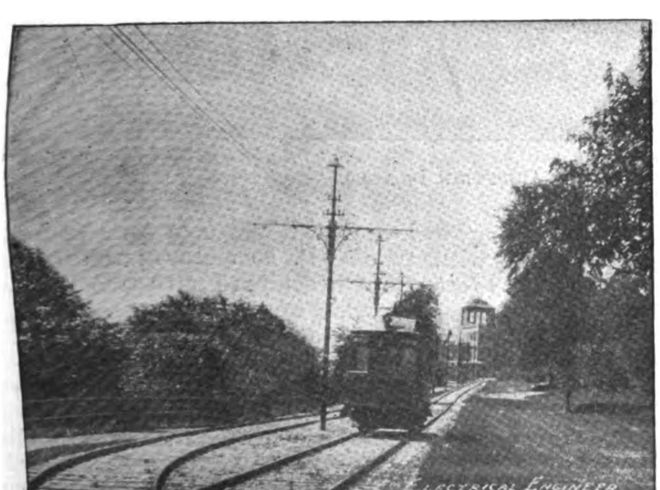
ONE OF THE OBSERVATION CARS.

frozen spray from the Falls made it extremely difficult to do anything except study the "ice bridge." In many places, four or five feet of pure ice had to be hewn away before the solid rock could be got at. Canal digging in summer sand is much easier.

The trolley wire throughout is No. 00 B. W. G. hard drawn copper, supported on iron brackets, provision being made for an additional bracket where the line is double tracked. I noticed one or two places where the turnout is on a slight descent and where the cars are allowed to make the detour by gravity, without provision for current supply. The plan works very prettily. All the overhead material is of the Thomson-Houston design, and Lieb clips are used except on curves, where the soldered ear has been found more satisfactory. The rails are bonded with No. 0 B. W. G. wire, and half-inch copper rivets, and cross bonded every fourth rail. Grounds are made in the river by means of No. 00 copper wire attached to a piece of standard rail, and also in many places along the track where facilities offered.

III.

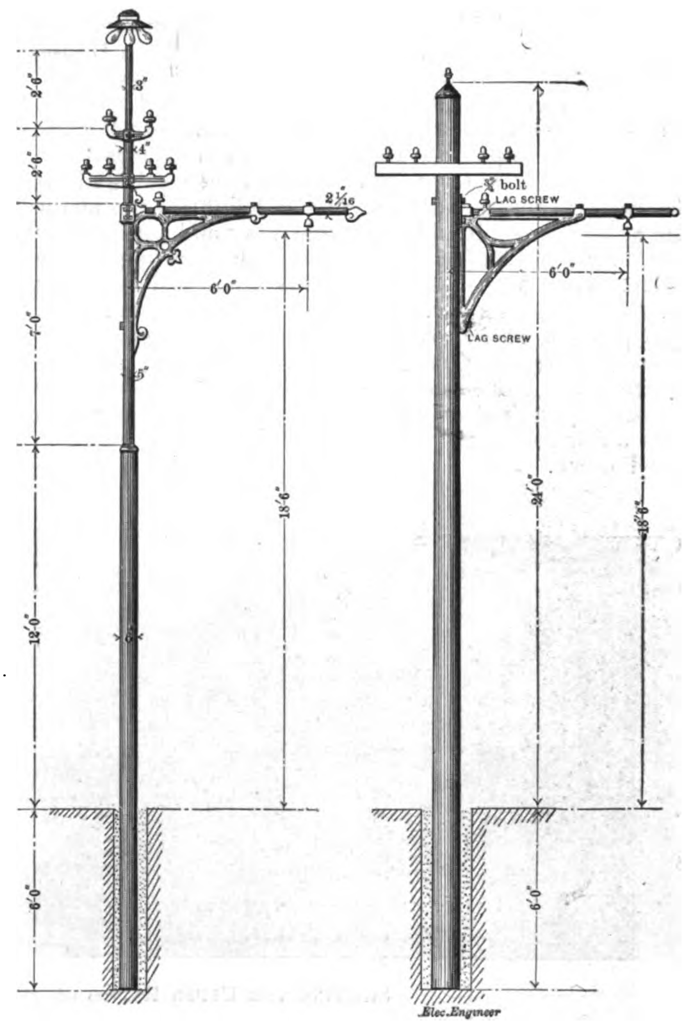
Meantime we have scaled the Queenston escarpment and have made our way out through Brock Park, well along the plateau overlooking the gorge against whose fretted strata of shale and limestone the Niagara River tears and plunges. A beautiful panorama unrolls before the flying car, and every moment a new vista opens through



THROUGH QUEEN VICTORIA PARK.

the oaks and firs. The road deserves to be called "the electric scenic route of America." Around Queenston, hitherto remote from the beaten tourist path, we obtain unfamiliar glimpses of forest and chasm, but after passing across the lofty trestle at Bowman's Ravine, territory is reached of which the robber hackman has heretofore allowed us to see something on payment of a heavy feudal toll. The return fare over the whole electric road is only 75 cents, so that while the scenery has been democratized there is an offsetting advantage in the taming of Niagara hack drivers, who on the Canadian side, at least, have become mild-mannered, soft-spoken creatures.

One of the pictures here given illustrates very effectively the dizzy nearness of the approach made by the road to the river. The motor car and trailer are on their way down to Queenston, with about 150 people on board. At this point the passengers on the right hand side are looking across to the American shore and directly down into the malachite Whirlpool. The foliage seen on the right of the

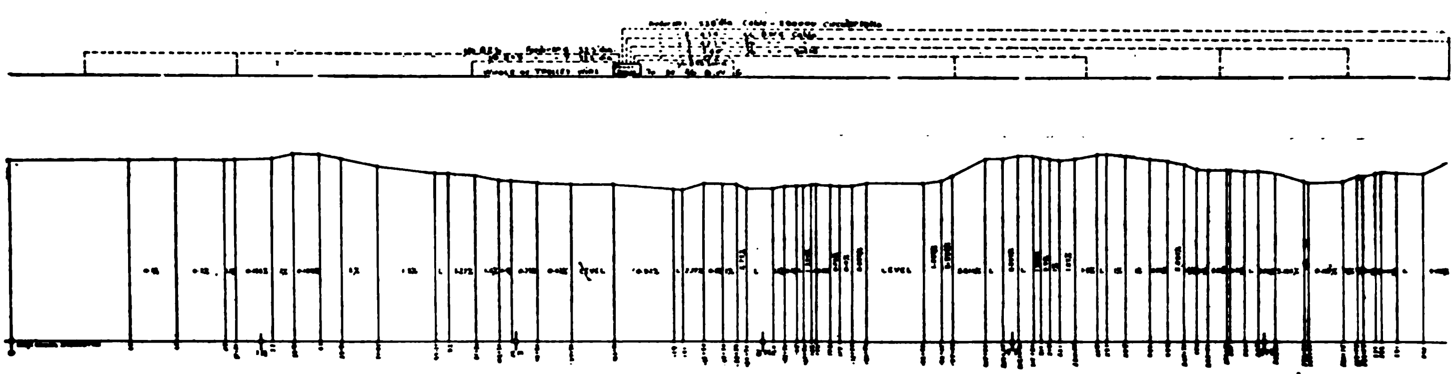


STEEL POLE AND WOODEN USED ON PORTIONS OF THE ROAD.

car is in reality hundreds of feet away on the other bank of the whirlpool; and the descent from the shelf of rock on which the car stands is sheer 250 feet to the edge of the slowly eddying dark green waters of the pool and the rushing current of the river, which here makes its right-angle bend to the lake.

From this point on, the road traverses ground that is hackneyed in more senses than one, but with the advantage that it brings the visitor nearer than ever before to the scenery of the river, and that the journey is made free from dust and touts. The railroad company has purchased most of the "attractions" along its route, or arranged with the proprietors for a concession in rates to its passengers "stopping over," all of which materially cheapens and simplifies the pleasures of Niagara for the multitude.

When we reach the town of Niagara Falls, the road

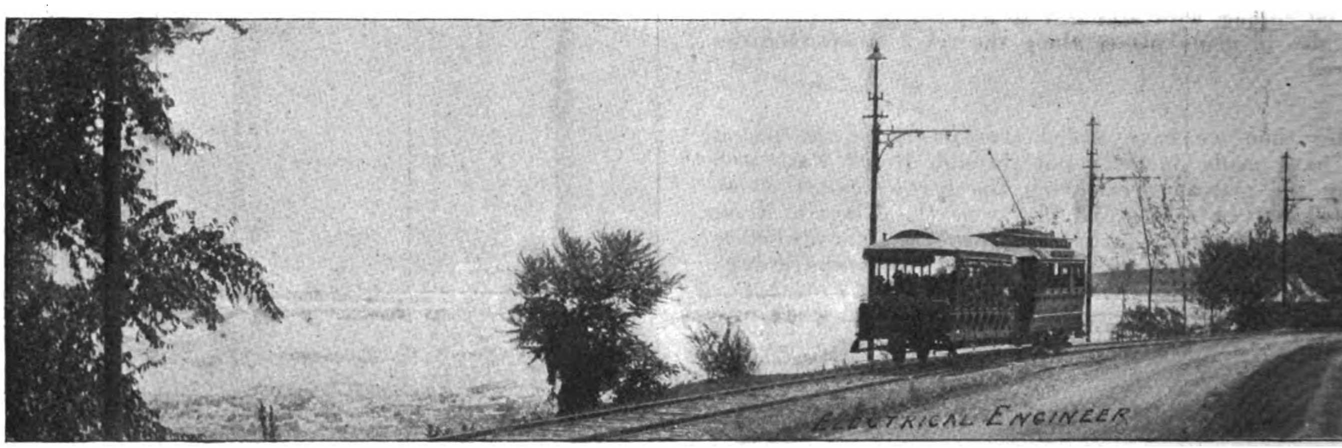


PROFILE OF THE NIAGARA FALLS PARK AND RIVER RAILWAY.

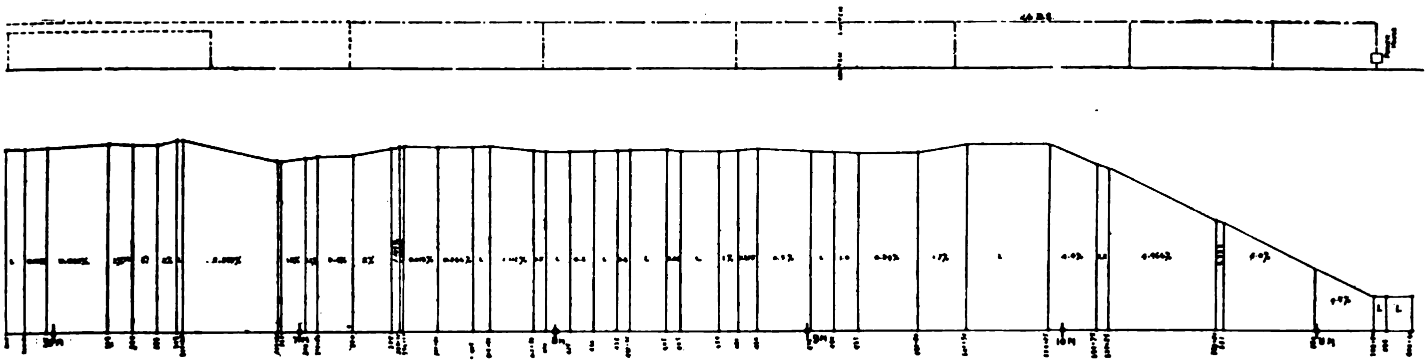
passes under the bridges and thence proceeds, on the very brink of the river, all the way, up to the Clifton House, where it enters Queen Victoria Park and exchanges from wooden to steel poles, some of which are included in a view given on page 123, taken just abreast of the American Falls. A little higher up at the Horseshoe Falls we come to the handsome stone water power house of the road, with its crenellated towers; and then make a delightful run at the edge of the Upper Rapids, through spray and sunshine, to the Cedar and Dufferin Islands, and the Burning Spring Bridge. Here the electric road has a series of three fine iron bridges of its own, views of which are given. The upper portions of the road beyond the Burning Spring bluff overlook the rapids, Goat Island and the cloud of mist rising from the Horseshoe, and afford a distant view of the extensive operations at Port Day, on the American shore, where a few more hairs of the Niagara Gulliver are being pinned down. Just beyond this point are the company's commodious car barns, and thence we glide into the quiet streets of indolent Chippewa, with Buffalo but a few miles away across the smooth and placid water. In about an hour we have made the long portage between the lakes, and have seen all the beauties of that which Father Hennepin described as "a vast and prodigious Cadence of Water." It is true that 200 years ago the portage was, as he says, "very good," and the forest not troublesome, save for the Indians haunting it; but I prefer the electric car to the old voyageur methods of transportation around waterfalls and rapids, unless I am out for a bit of backwoods rough camping myself.

IV.

The electrical equipment of this superb road is entirely the work of the Canadian General Electric Company, of Toronto, and the work on the overhead construction was done under sub-contract by the Ontario Construction Company. Mr. Frederic Nicholls, the general manager of the Canadian General Electric Company, aided by his superintendent, Mr. G. Stephens, gave the equipment the closest and most enthusiastic attention from the first, while his chief engineer, Mr. W. Rutherford, has supervised the construction throughout. I am indebted to Mr. Nicholls and Mr. Rutherford for many personal courtesies when collecting data for this article. The motors, generators, etc., were manufactured at their Peterboro, Ont., shops, and, I must confess, look somewhat superior in careful finish to our own American machinery of like make. The wire was drawn from English copper rods by the Dominion Wire Manufacturing Company, of Montreal, and insulated at Peterboro. The rubber-covered wire used in the power house and in wiring the cars is also the Canadian General Company's wire, known as "C. C." (Canadian Core). Of the generators I shall speak later in dealing with the power house. The rolling stock equipped consists of four 18-foot ordinary box cars with two W. P. 50 motors; ten open cars measuring 28 feet over all, equipped with two W. P. 50 motors; and ten observation cars measuring 35 feet, mounted on double trucks and equipped with two W. P. 50's. All these motor cars are furnished with controllers of the "E" and "K" type similar to those of the same name used in this country. Besides the motor cars, there are 18 open and closed trail cars. The work on the motors has been extremely heavy. Thus, ever since the Queen's Birthday (May 24) when the road opened, the motor cars have been run in regular service with a trailer; and the observation cars weigh when loaded about 20 gross tons. A fair load for one of these observation cars the week I visited the road appeared to be about 110 passengers, with which they would swing up the Queenston five per cent. grade without any sign of strain or effort. I know something of the

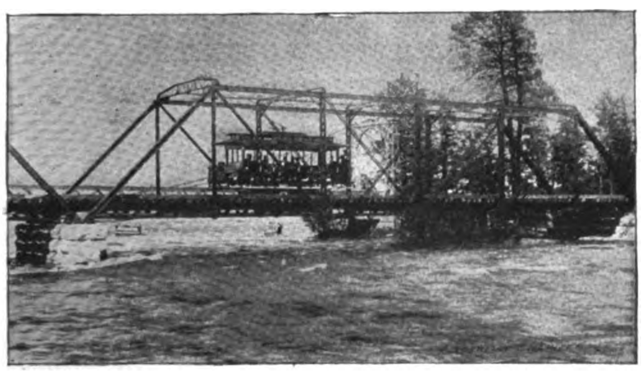


SKIRTING THE UPPER RAPIDS ON THE WAY TO THE DUFFERIN ISLANDS.



PROFILE OF THE NIAGARA FALLS PARK AND RIVER RAILWAY.

endurance of the apparatus as, in order to watch it during a recent stay at Niagara, I spent one whole day on the road without leaving it from 9.30 a. m. to 5.30 p. m.,



BRIDGE BETWEEN THE DUFFERIN ISLANDS.

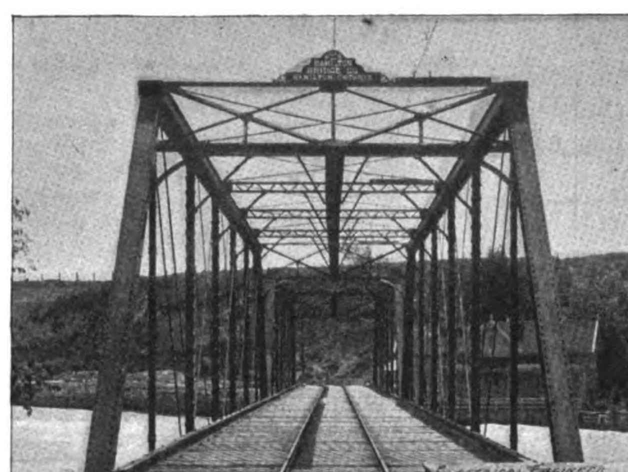
and did not see in all that time a single light-loaded car. No fewer than 17,126 passengers were carried that day, and there have been many such tests this season, speaking volumes for the excellence of the apparatus and the shrewdness of the investment. But there has been absolutely no breakdown at all, and I never saw cars that went through their paces better. Even the Niagara River lightning, which is a famous special brand, has not "phased" the motors, but up to date, thanks to the Thomson-Houston design of lightning arrester used, no damage has been done, although one car was struck four times in a bad quarter of an hour. The neat car bodies

THE CAR BARNS.

are the manufacture of Paterson & Corbin, of St. Catharines, under specifications prepared by Mr. Jennings, and while perhaps a trifle stiff to an American eye, are, it may be, designedly heavier than usual. In addition to the cars above mentioned, there is a private car, for royalty and editors; and a 20-foot baggage and fruit car will soon be running. The country around for miles is a veritable orchard, and the road will handle large quantities of peaches, grapes, etc., in the near future.

The road is in operation every week day for 15 hours and every Sunday for 12 hours. I have already stated that the round trip fare is 75 cents, but between the town and the Falls the fare is only five cents either way. Cars will run over the whole of the road until the end of October, when the tourist and excursion season ends, and then the outlying sections will shut down. I fancy that the frozen spray of the Falls will severely test the overhead wires and feeders in the upper section during winter, if all left up, as its weight will be enormous at times.

A pretty feature of the road through the Victoria Park



ELECTRIC RAILWAY BRIDGE AT THE BURNING SPRING.

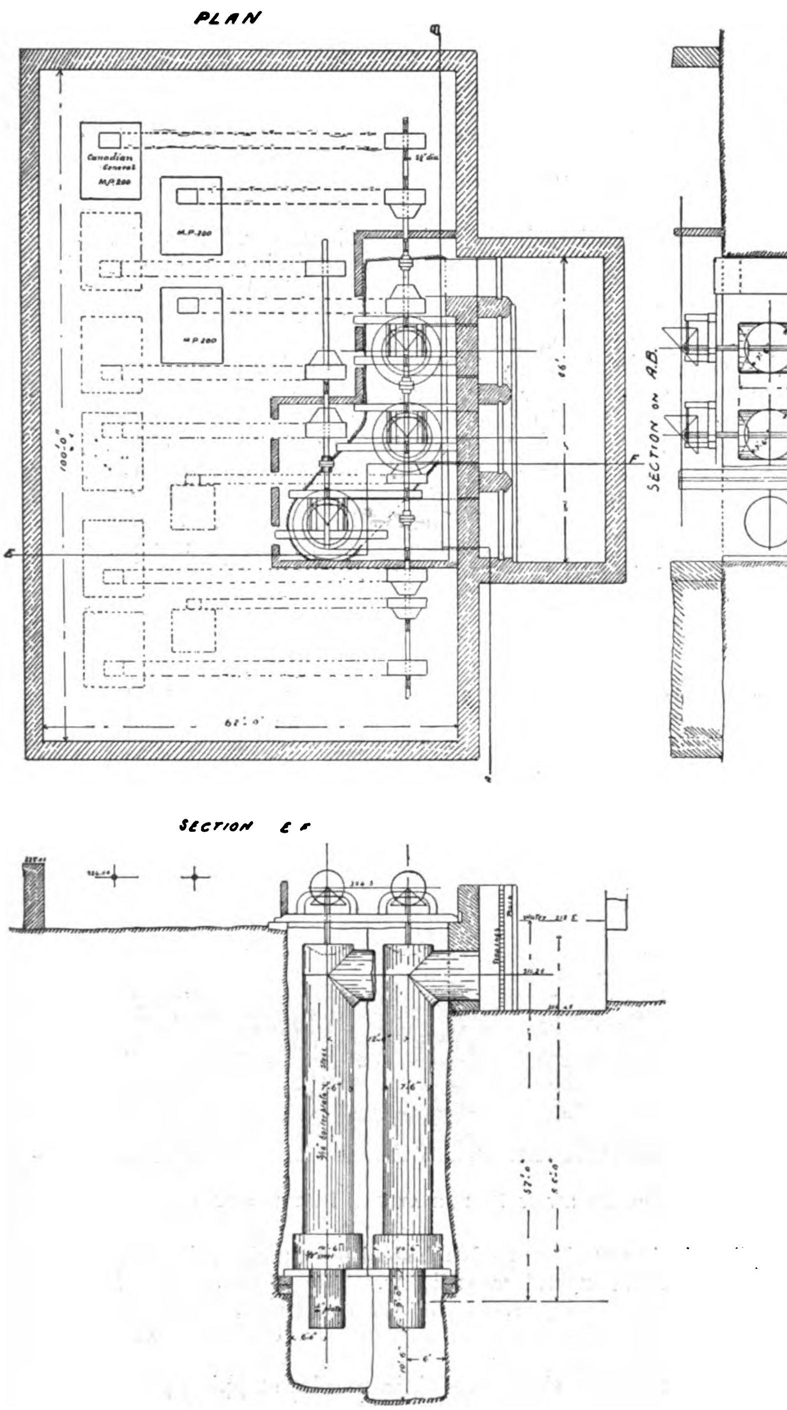
is the placing at the top of each steel pole, under a hood, of a group of five incandescent lights. The effect of these is particularly pleasing from the American side. The cars are also all lighted electrically and have electric head lights.

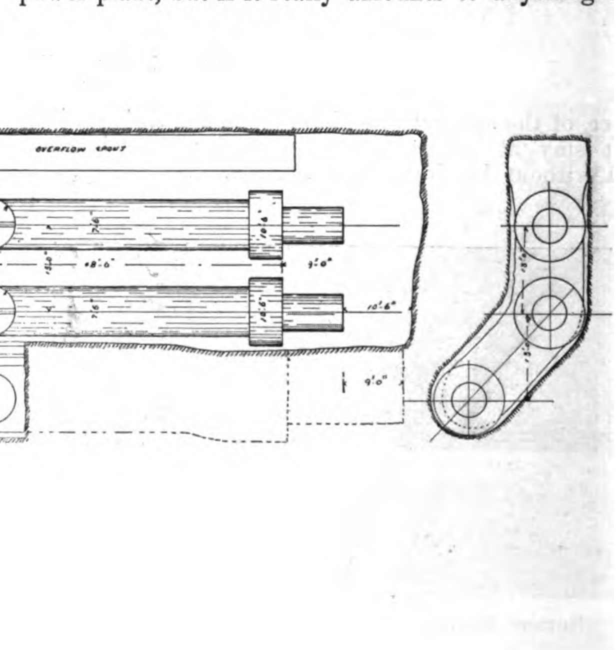
Along the line there are eight regular stopping places with raised platforms, but halt is also made on call. There are 20 turn-outs, and I think the heavy travel would be helped if there were more. The management is now looking up the subject of block signaling with a view to the quicker handling of its cars.

The roadbed certainly will stand the load of the heaviest traffic, and the bridges, furnished by the Hamilton Bridge Company, of Hamilton, Ont., have a factor of safety large enough to enable the road to handle railway traffic in the fullest sense of the term. The views given of the bridges show their solid construction. There are three regular bridges, and the Bowman's Ravine trestle, which is 500

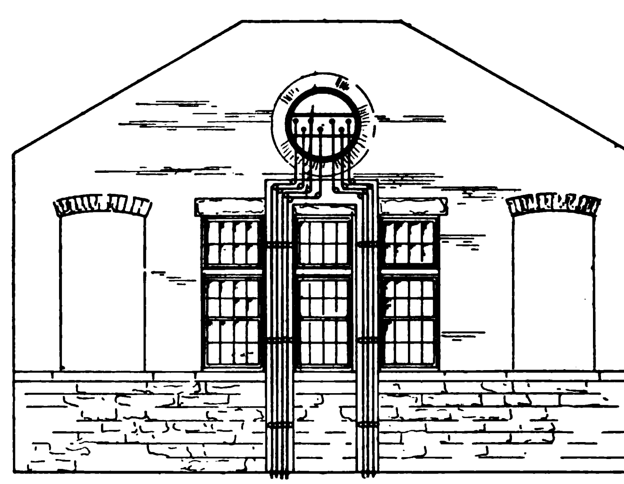
feet long and 135 feet high. The bridges, with the exception of Bowman's Ravine trestle, are all above Victoria Park and across rushing water needing heavy piers. One of the bridges has two spans of 150 feet each.

Before leaving the line work I ought to mention the fact that the cars have very heavy 33-inch wheels. They weigh 500 pounds, with $3\frac{1}{2}$-inch tread and $1\frac{1}{4}$-inch flange. Another feature I observed was the use at one or two points on the road, of cattleguards, which might wisely be adopted in some American city streets, to keep loungers off the tracks.





Plan of Niagara Falls Park Railway Power House.



Feeder Outlet From Power House.

V.

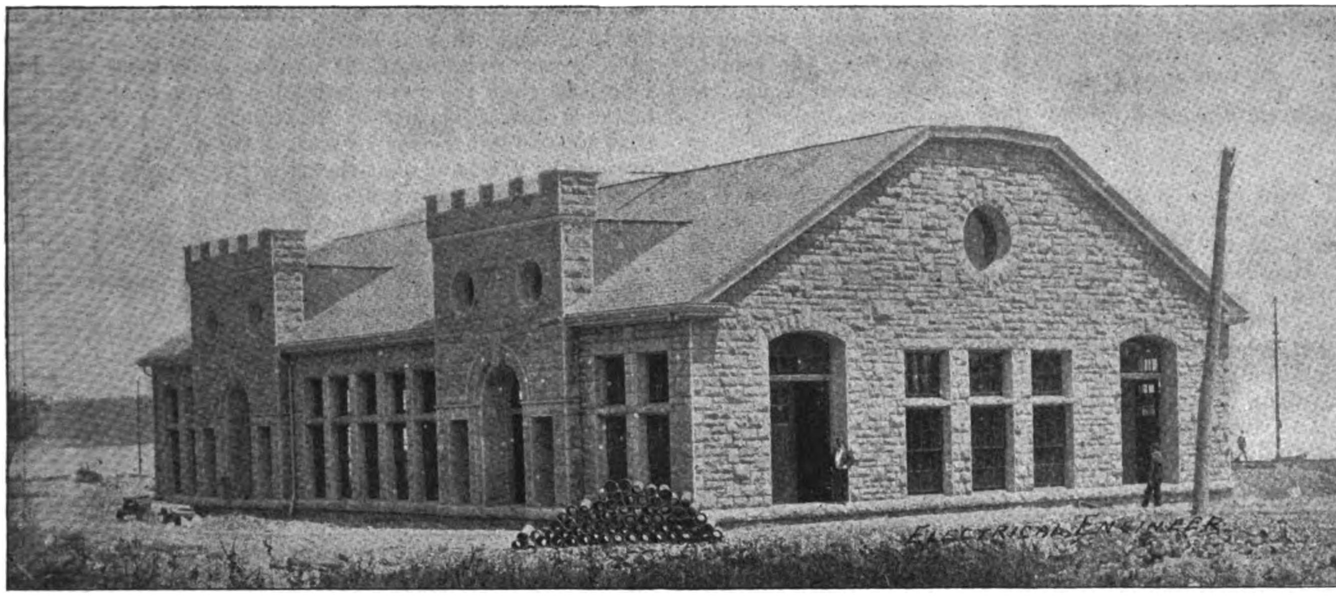
The power house is a structure well in keeping with the other edifices in Victoria Park, and is of the most solid construction. Here the power of Niagara is utilized electrically for the first time on the Canadian side, and upon such an extensive scale as to exemplify the results possible when the Niagara region has become, as it undoubtedly will ere long, a great manufacturing centre. The water is led from the rapids just above the Falls, by an unobtrusive flume 200 feet long to the gates, where it is taken in to run two 1,000 h. p. turbines under a head of 62 feet, and then passes out by a tunnel about 600 feet long, to the Horseshoe Falls, under whose gigantic sheet of foam it is discharged, joining the 1,350,000,000 cubic feet of water that pass every minute over that wondrous curve now fast becoming a "V" with acute angle. I cannot say that I note any diminution in the flow over the Horseshoe, due to the power plant, but if it really amounts to anything it may retard the destruction of the beautiful contour of the fall by relieving it of part of the enormous burden now imposed on it. The fate in store for Niagara unassisted by man is to become a long series of rapids, but the relief now promised her should actually preserve and perpetuate her beauty rather than destroy it.

The power house building, of which a plan is shown, is 100 feet long by 62 feet wide, and contains ample accommodation for three large turbines. The two

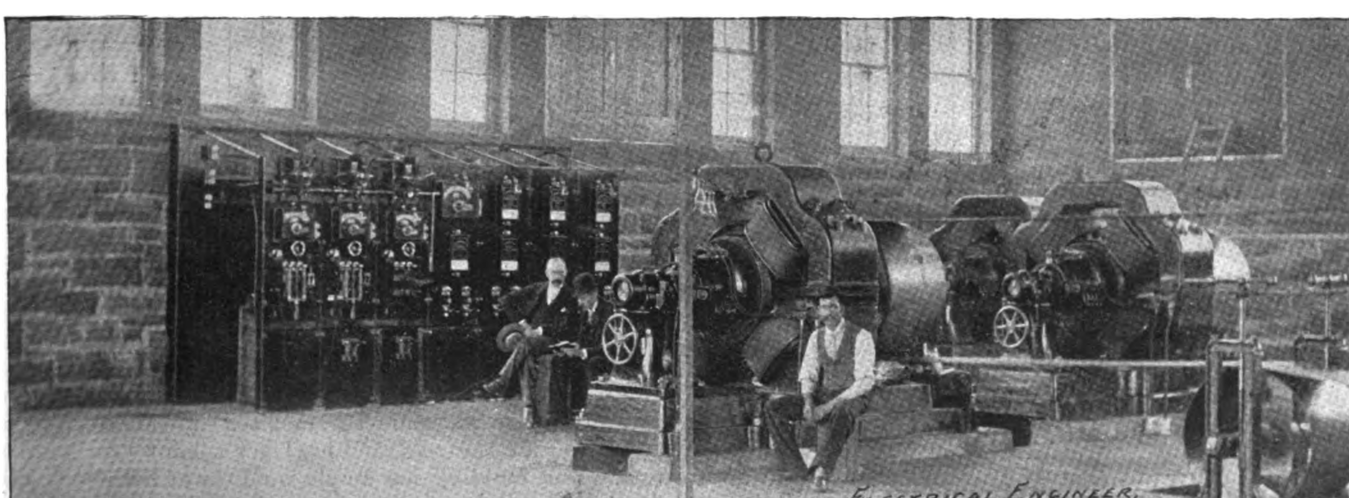
already installed drive by means of the main shafting and friction pulleys shown, three Canadian General Electric "M. P. 200" generators, of most admirable construction, which represent a total capacity of about 800 h. p. These generators are compounded for 20 per cent. loss, and are connected through three standard Thomson-Houston generator panels to the feeder board. The connections between the machines are such that they can be run in multiple, or separately at different voltages, so that if found necessary one dynamo can be operated at a higher voltage and connected to the longer feeders. Each feeder is provided with a separate safety catch and amperemeter. The dynamos stand on pier foundations of solid rock, and are absolutely free from vibration; so free in fact that on going outside the power house one is immediately conscious again of the dull tremor due to the tremendous pounding of the water as it descends over the Falls. The circuits are led from the machines under the floor to the wall where, as shown, they are carried in excellent fashion up to and out of the circular window and thence to the pole line.

The turbines are about 45 in. in diameter and are of the Leffel type. They were built by W. Kennedy & Sons, of Owen Sound, Ont., who call them the "New American." The specification required them to be each capable of developing 1,000 h. p. under 55 feet head of water, and capable of working with any head up to 63 feet. Provision is made at the gates against needle ice, and the construction of the wheel cases, penstocks, draft tubes, gates, gears, standards and pillow blocks is of the most solid and enduring nature. The wheels are geared to give a speed of 250 revolutions per minute on the line shaft.

There is a supplementary steam power house at the Queenston end of the line, containing two Canadian General Electric "M. P. 100" generators belted direct to two Wheelock condensing engines running at 90 revolutions, built by Goldie & McCulloch, of Galt, Ont. This steam plant is only intended for use in the busy summer months when large excursions of 1,000 to 1,500 people are constantly being landed at Queenston from the Toronto steamers, and require to be taken in swarming carloads up the mile and a half of five to six per cent. grade. In ordinary running, this station is shut down, and the trolley and feeder are connected at station 480, so that the whole of the road can be run by the Falls plant. Be-



POWER HOUSE OF THE NIAGARA FALLS PARK AND RIVER RAILWAY CO., NIAGARA FALLS, ONT.



CANADIAN GENERAL ELECTRIC DYNAMOS AND SWITCHBOARD, NIAGARA RAILWAY POWER HOUSE.

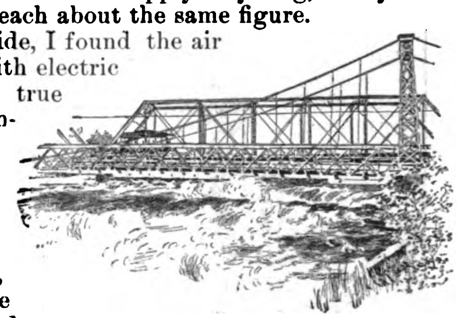
The Vista of the Bridges

fore this plan was adopted careful studies were made, and it was found that beyond a doubt, in view of the heavy duty exacted by such work, it would be cheaper to install this plant than to transmit sufficient power from the remote main power house to handle the thronged cars on these grades.

VI.

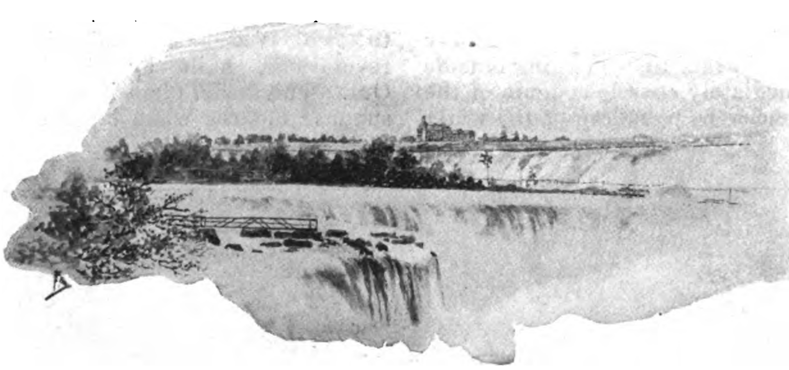
I have already stated that the Niagara Falls Park & River Railway Company is a Canadian enterprise. Its president is E. B. Osler, of Toronto; and the other officers are, W. Hendrie, of Hamilton, vice-president; R. A. Smith, of Toronto, secretary and treasurer; W. A. Grant, Niagara Falls, Ont., manager; W. Phillips, electrical engineer and superintendent. Mr. Grant, whom I have to thank for much kindness and information, is a keen, bright young Canadian, formerly private secretary to Mr. Van Horne, of the Canadian Pacific Railway; and his personal attention to details is manifest on every part of the system. He informs me that the road has a capital stock of $300,000, and may be bonded up to $45,000 per mile. It has cost up to date about $600,000. Besides the annual payment to the Government of $10,000, the company had to give a bonus of equal amount before beginning operations. This first year of operation might well be considered experimental as to traffic, in spite of the success achieved; and Mr. Grant has many emprovements in the service in contemplation. He is not satisfied, moreover, with the traffic from the Canadian cities, although it swamps his carrying capacity even now; and I expect that in a short time he will be hauling as many people from Buffalo, through Chippewa to Queenston as he now brings through Queenston from Toronto up to Chippewa. It is a natural, easy, and beautiful line of travel, and the most will be made of its opportunities at both ends.

Nor is this all. At the Chippewa terminus, there is a switch connection with the Michigan Central Railroad, and not far from the other end is a switch connecting with the Grand Trunk. Such facilities cannot possibly long lie idle, and though daisies are nodding to-day over those grassy switches, their hour of usefulness is at hand. I noticed that the road derived a large patronage from our own side, a fact not at all strange when we remember that 300,000 Americans visit the Falls on cheap excursions during the year, and that the supply of young, newly married couples must reach about the same figure.



Burning Spring Electric and Foot Bridges

On the Canadian side, I found the air literally buzzing with electric railway talk. It is true that down at Queenston, Mr. Nicholls and I, in search of food, encountered in the custodian of some dusty pie a pessimistic native, who did not believe that the electric road could restore to the village the 25 postal clerks it employed in the forties, before the Grand Trunk sapped its vitality; but even Queenston will be electrified. Its historical associations will now draw antiquarians, while its fine boating and fishing will help fill a big hotel up on the breezy heights. All around it stretches the richest of orchard land and farming country, and from all that I can make out, in a very few years the whole smiling plain will be covered with a network of prosperous electric roads all centering, as did the old highways, at the foot of the portage to Chippewa.



A Glimpse of the Road from Goat Island Across the Horseshoe

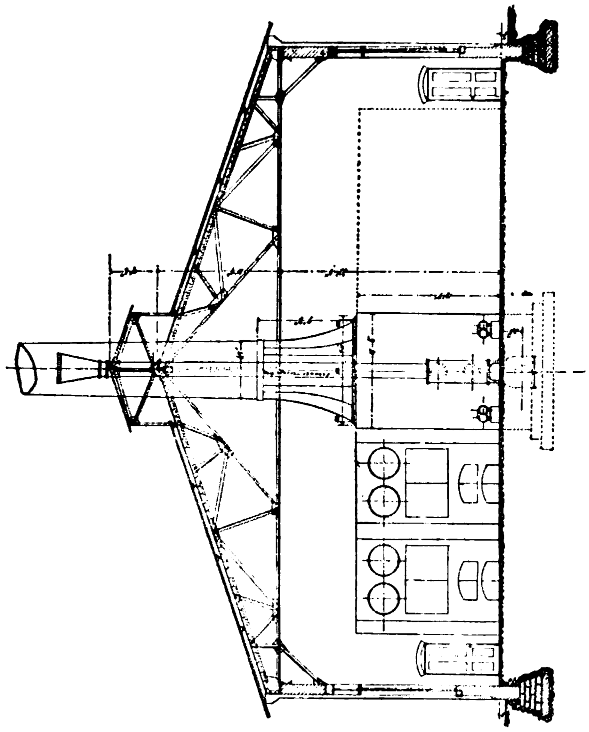
THE ELECTRIC POWER HOUSE FOR THE SPRAGUE ELECTRIC ELEVATOR COMPANY'S FACTORY AT WATSESSING, N. J.

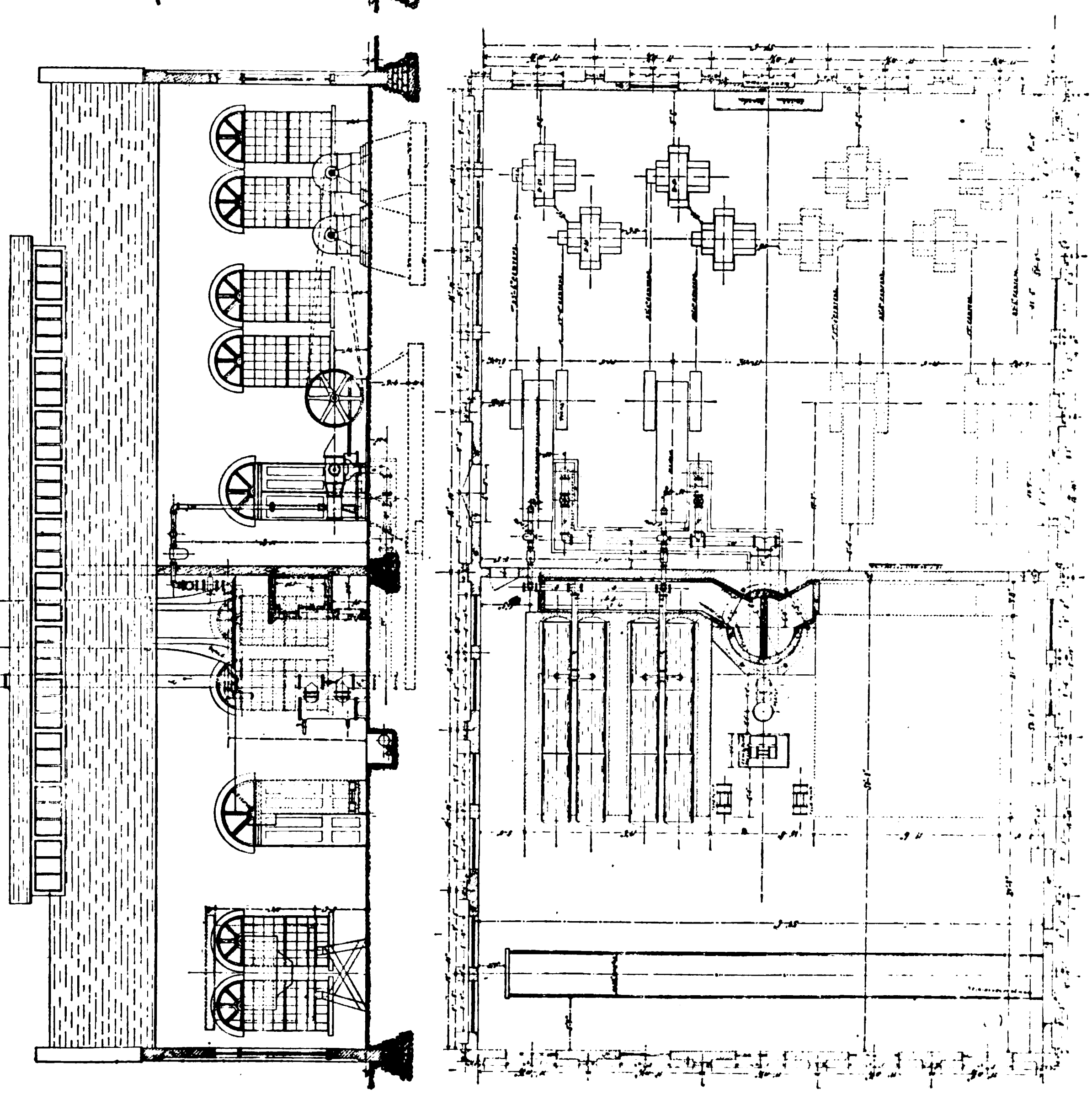
At the present moment, the Sprague Electric Elevator Company are building a large factory at Watsessing, N. J., a few miles from New York City, and are preparing to equip it in such a way that electricity alone will be utilized for power. The factory itself is a modern steel frame building of handsome proportions, and easily capable of accommodating the several hundred men to be employed in the manufacture of the Sprague-Pratt elevator, but the resort to electricity in driving the machine tools, hoists, cranes, etc., is expected by Mr. Sprague to result in a marked economy of labor as well as in expediting the work through the shops.

The power house for this large factory is illustrated in the accompanying plans and diagrams. It is a fine structure, 104 feet 4 inches long by 62 feet 2 inches wide. It is of composite construction, with steel columns, single span trusses and monitor roof, with brick filling and pilasters around the columns. The roof is supported by steel purlins and slate covered, while the monitor extends over about two-thirds of the roof and has lever windows for ventilation. The building has ample windows at both ends, and doors and windows on either side. It is divided in the middle by a fire wall extending to the roof line.

The clear light under the truss chords is 21 feet 8 inches, and the total height of the building is 37 feet 1 inch. The building is adjacent to the junction of two railroads, and a branch elevated trestle runs from them right into it for dumping coal.

The power house is designed with a view to affording a normal supply of about 600 h. p. to the factory for all purposes. Its first equipment consists of a battery of two





Electric Power House
for the
New Factory
of the
Sprague Electric Elevator Co.,
Watsessing, N. J.

Babcock & Wilcox water tube boilers of 304 h. p. capacity arranged to carry 104 pounds steam pressure. The boilers and flues back up against the fire wall to give the most direct steam outlet to the engines; and there is also abundant fire room, and coal storage capacity under roof. The flues open with a reverse bend into a brick foundation stack of the same height as the boiler setting. On top of this is carried a self-supporting fire-brick lined steel stack 90 feet high, making a total height of 104 feet for the chimney.* This steel stack is the product of the Philadelphia Engineering Works, as illustrated recently in THE ELECTRICAL ENGINEER.

The engine plant consists of two 150 h. p. engines built by McIntosh, Seymour & Co, of Auburn, N. Y.; they are of the tandem railway type, with cylinders 13x19x15-inch stroke.

The boilers are fed by two $7\frac{1}{2}$ x $4\frac{1}{2}$ x 6-inch Smith & Vaile boiler feed pumps, each of 600 h. p. capacity. There is also a drain pump for draining the live steam pipes and the cylinder jackets. The plant is also provided by a No. 14 Wainwright feed water heater, two Robertson separators, a Locke damper regulator and a Edson recording gauge. Special care has been given to the piping, which is extra heavy and flanged and jointed throughout. The Chapman valves are employed throughout the plant with special heavy bronze gate valves, the joints being packed with nickeline metal. All piping is covered with the H. W. Johns Manufacturing Co.'s asbestos. The piping is arranged for an automatic drainage, which is returned directly to the boiler, and the valves are so placed that any engine or boiler can be put into, or out of, service without interfering with the remaining part of the plant. The exhaust pipe is laid in a masonary trench with iron covers which is ventilated at each end to keep the engine room cool. Each of the two engines drives a pair of D. 50 Thomson-Houston compound wound dynamos. From these will run what may be called "omnibus" mains; in other words they will take care of all the classes of service, whether it be the operation of the main cranes, of the tools and shafting motors, of the testing of elevators in the four special towers of the factory, and of the general lighting by arc and incandescent lamps. Mr. Sprague believes that this can be successfully accomplished from the same mains without any class of service suffering from the operation of the other.

Water for the boilers is to be supplied either from the East Orange Works or from an artesian well on the premises. All the work on this interesting power house and not less interesting factory is being done under Mr. Sprague's personal supervision, with the coöperation of Milliken Bros., who supply the steel work, Pierce & Miller Engineering Company, who have the installation of the engines and steam plant; and the Sprague Electric Elevator Company, who are doing all the electrical work.

MANURES AND DYING MORDANTS BY ELECTROLYSIS.

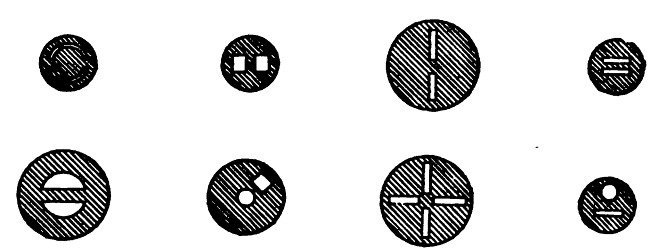
WHEN to a solution of ferrous sulphate, a weak solution of the protochloride of iron, sodium, potassium, calcium, vanadium or magnesium, has been added, a basic sulphate of the peroxide is formed, and the addition of an equivalent of sulphuric acid, either before or after electrolysis, causes the formation of the trisulphate of peroxide of iron—a substance which can be used with great advantage in slaughter houses for the preparation of dried blood manure. MM. Hermite and Dubosc have developed this idea into commercial importance during the past few months. They cause the ferrous sulphate to circulate through an electrolytic apparatus arranged to maintain a maximum proportion of the salt in solution; in this way they obtain a completely saturated solution of the sulphate of the peroxide. By varying the current density and its duration, a greater or less quantity of this substance may be formed, constituting the various dying mordants known as "rust," "sulpho-nitrate," and "persulphate of iron." The apparatus in which this is effected consists of an enameled iron tank, with an outlet at the bottom for running off the contents when required; a perforated pipe in the lower part of the tank for supplying the solution to be acted on, and an overflow outlet in the upper part. The electrodes are plates of iron alternating with thin platinum sheets.

PREECE'S SUBMARINE CABLE FOR HIGH SPEED SIGNALING.

IN his inaugural address as president of the London Institution of Electrical Engineers, delivered last January, Mr. Wm. H. Preece, alluded to the fact that he had recently devised a new form of cable which would probably quadruple the rate of cable work across the Atlantic, and he went so far even as to record his belief that there was no theoretical reason why London should not be in telephonic communication with every capital in Europe and that speaking across the Atlantic was not impossible.

Neither on that occasion nor subsequently, so far as we are aware, has Mr. Preece vouchsafed any details regarding the nature of his new cable, but the recent issuance to him of a British patent for "Improvements in Submarine Telegraph Cables," throws some light on his previous utterances.

In this patent Mr. Preece refers to the well-known fact that in long submarine cables as at present constructed, the speed of working, and therefore the rate of flow of



PREECE'S SUBMARINE CABLE FOR HIGH SPEED SIGNALING.

successive currents, whether intermittent or alternate, is regulated by the electrostatic capacity and the resistance of the core. It follows a distinct and definite law which is expressed as follows: speed of waves varies as $K R$; K, being the total inductive capacity and R the total electric resistance of the core.

Mr. Preece states that he has found by experiment that the value of K can be very materially modified by the influence of mutual induction between two parts of the circuit when the circuit is metallic and the core compound; in fact the geometrical relations between the insulator and conductors can be so modified that K may be practically eliminated.

In submarine cables he proposes therefore to avoid the use of the earth as a part of the circuit, and to make the circuit entirely metallic. To that end he constructs the core of two conductors either cylindrical and parallel, or cylindrical and concentric, or rectangular and parallel, separated from each other and from the water by insulating media, and so arranged as regards geometrical form, that the effect of the mutual induction of the two conductors shall oppose and neutralize the effect of their inductive capacity. In this way, Mr. Preece proposes to materially expedite the rate of working by telegraph, to extend the distance to which speech by telephone through submarine cables is possible, and to eliminate from cable working many existing sources of trouble and difficulty owing to the use of earth.

The accompanying illustrations show a number of sections of various forms and arrangements of submarine cable cores having two conductors forming a complete metallic circuit, according to Mr. Preece's invention.

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THE PERFORMANCE OF ELECTRIC RAILWAY POWER PLANTS.

ELECTRIC railway practice is undergoing much the same intricate evolution witnessed in the gradual development of electric lighting, and, indeed, the frequent anomalous results which we see recorded make it doubtful whether the true standard of practice can yet be said to have been reached. Strange to say, this uncertainty does not by any means rest so much upon the electrical as upon the purely mechanical equipment and more particularly upon that of the power house. Shall it be large triple expansion engines, direct connected, or driving generators through shafting and belt, or the earlier smaller unit belting direct to the generator? These are questions the answer to which the electric railway engineer is still seeking. But a recent contribution to this subject of more than ordinary interest is that embodied in an exhaustive paper presented by Messrs. Wm. A. Pike and T. W. Hugo, before the Mechanical Engineering Section of the World's Engineering Congress just terminated at the World's Fair. At the instance of Mr. Thomas Lowry, president of the Twin City Rapid Transit Co., Minneapolis and St. Paul, Minn., the authors undertook a series of tests of the various power plants of the company to determine the cost of motive power per car mile with the different types of power arrangements existing in the cities mentioned. The opportunity here existing will be manifest when it is considered that the company has in operation three stations, two of which are run each by a pair of three-cylinder Corliss engines built by Messrs. E. P. Allis & Co., and belted to countershafting with clutches, and one operated by 10 Westinghouse compound non-condensing engines. The maximum horse-power of the plants was, respectively, 2,000, 1,600 and 1,000 h. p. Without entering into details, the results showed that in the "concentrated power" stations employing triple expansion engines the total cost per car mile for power amounted to 1.6398 cent, while for the "subdivided power" station the cost aggregated 1.703 cent, or 3.2 per cent. more. The authors point out, however, that if the steam furnished to the Westinghouse engines had been at the pressure contracted for, namely, 140 pounds, the saving in fuel would have been at least 6 per cent., which would have brought down the cost per car mile to 1.615 cent for the Westinghouse plant, or 1½ per cent. below that of the others. This practical equality of performance with engines of radically different types might at first create surprise, but an analysis of the results shows in what direction the causes are to be looked for. Examining the friction loads, for instance, we note no less than 12 and 17 per cent. at maximum load for the triple expansion engines with countershaft, against 3.7 for the Westinghouse engines belting direct. In the former two cases these percentages would, of course, be greatly increased at light loads, while that of the Westinghouse plant could be, and is, made practically constant for all loads on account of the ability to shut down engine after engine as the load falls off. Besides, as the authors point out, the very rapid regulation of the smaller engine as compared with their larger rivals, must necessarily lead to greater economy. In determining the results above arrived at, it was, of course, necessary to take into account the interest on real estate, cost of engines and boilers, shafting, belting, etc., and here we note that for a practically equal power capacity the station equipped with triple expansion engines cost $105,500, while the station with Westinghouse engines cost but $61,500, or a saving in capital outlay of nearly 40 per cent.; while the cost of labor for the "concentrated power plant" was $35.50 per day against only $16.83 for the subdivided.

While tolerably conclusive as to the relative merits of the two types of engines tested under the conditions existing in electric railway operation, this still leaves undetermined the position of the triple expansion direct-connected generators now largely coming into vogue. This type of engine would, of course, eliminate the large item of friction above alluded to in reference to the triple expansion engine, plants with countershafting, but it would remain to be seen whether it would be able to cope successfully, that is, economically, with the large and frequent fluctuations in load on the one hand, and the continuous long periods of light load on the other.

Among the numerous other tests conducted in order to ascertain the conditions of best working, was one to determine the relative economy of burning coal as against oil. Taking the cost of the latter as equal to 2.26 cents per gallon, their tests show that with coal at $2 per ton there is a saving over oil of 37.1 per cent. This disparity, however, disappears with increased cost of coal so that in the neighborhood of $3.75 per ton the two fuels stand on practically the same level as to cost; with coal at $4.85 per ton the saving with oil would amount to 19.5 per cent. These are instructive figures, and might be practically applied in many cases.

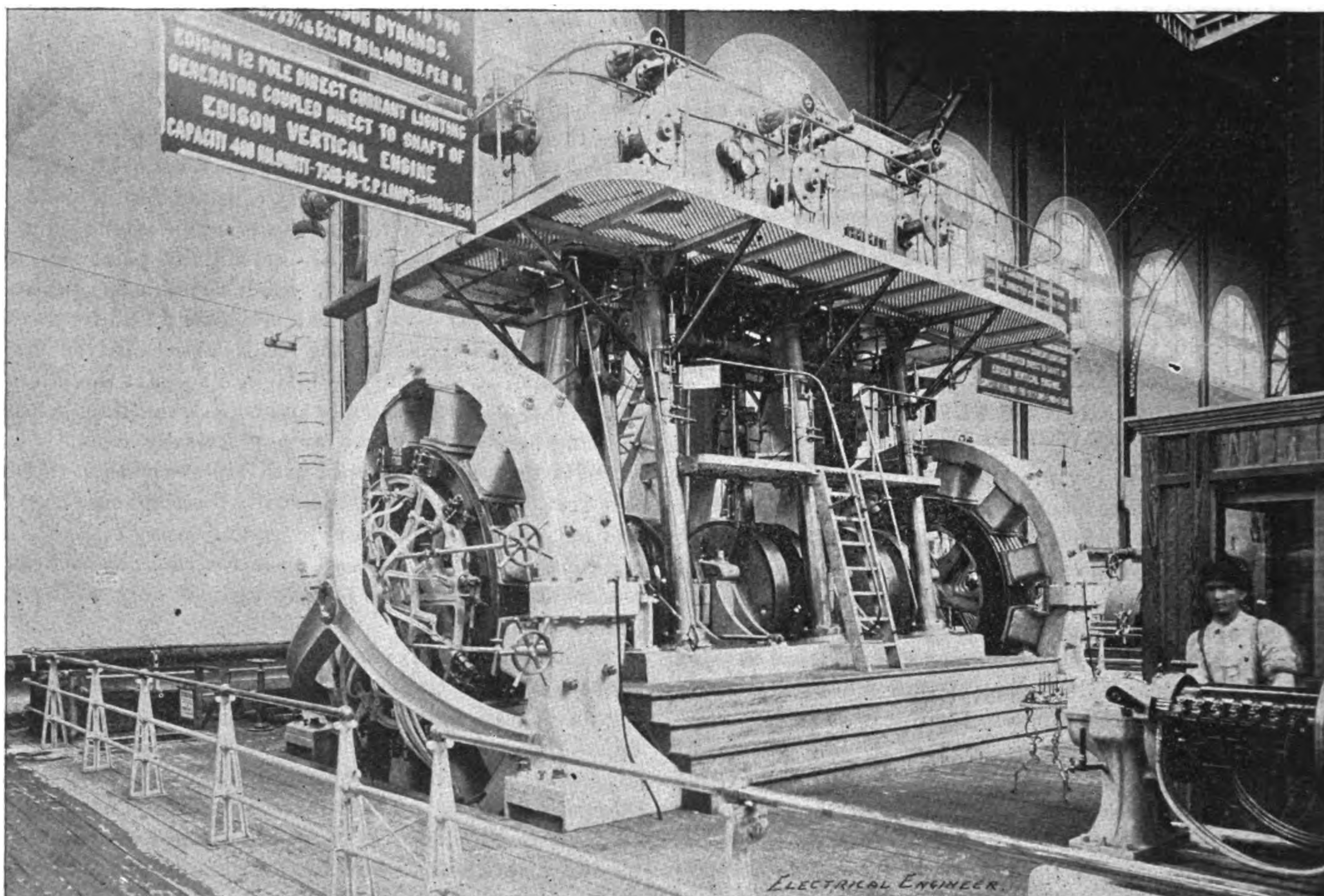
WORLD'S FAIR DEPARTMENT.

GENERAL ELECTRIC COMPANY'S MULTIPOLAR GENERATOR DIRECT DRIVEN BY TRIPLE EXPANSION ENGINE.

PERHAPS in no other department of the electrical exhibit is greater progress observable than when comparing the dynamos of ten years ago with those at the Fair. This applies as well to the design as to the size of the units. Mere size is, in itself, nothing to boast of, as a rule, but in the present instance, it indicates in the first place that the electrical engineer has recognized one of the essentials to attain economy in operating large central stations, and, again, that the art is sufficiently advanced to enable him to successfully construct such large units.

As an example of American progress in this direction, the 1,000 h. p. multipolar generator of the General Electric Co., situated in Machinery Hall attracts deserved attention. This combination consists of two 400 kilowatt generators driven direct by a triple expansion engine designed by Mr. J. C. Henderson, chief engineer of the company. The general construction of these generators and engines has already been described and illustrated in these columns but among the improvements introduced in this later type is the substitution of Corliss valves for those of the piston type used heretofore.

As shown in the accompanying engraving, the valves are placed in the heads, giving the smallest possible percentage of clearance, and are closed by steam dash pots, operated by the pressure in the steam chest. In the intermediate and low pressure cylinders the action of the dash pot is assisted by springs, as the pressure in the receiver is liable to be reduced to a point not sufficiently above the atmospheric pressure to effect a prompt closure. In this situation, they are out of sight and entirely noiseless.



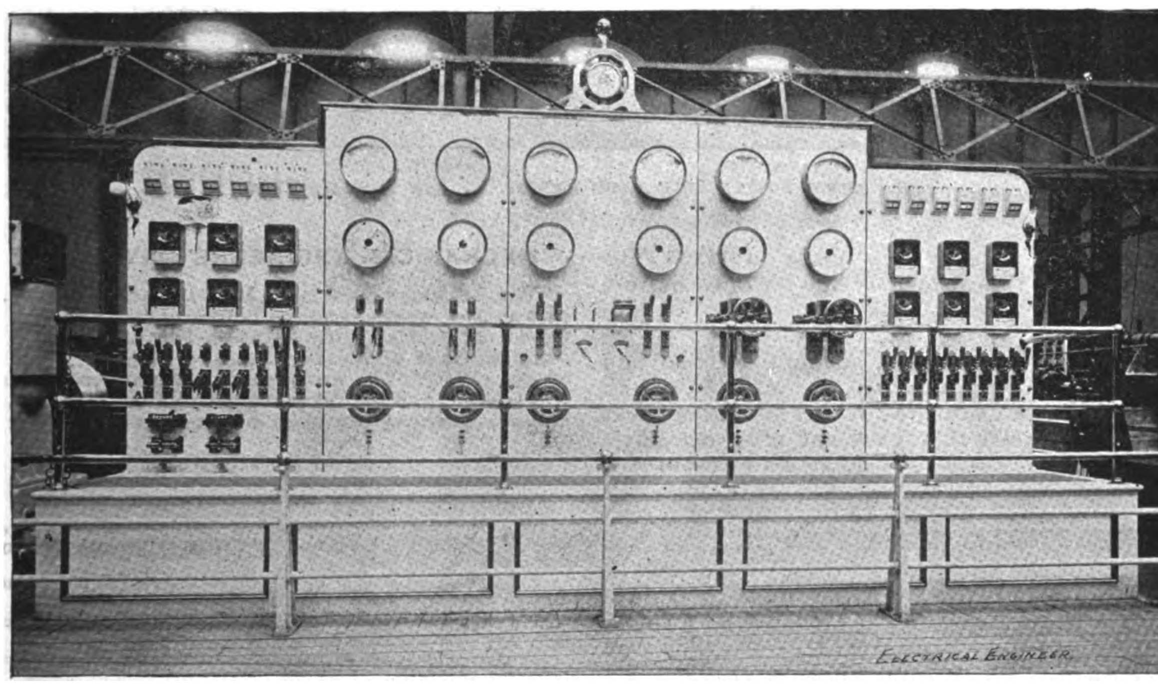
GENERAL ELECTRIC COMPANY'S MULTIPOLAR GENERATOR DIRECT DRIVEN BY TRIPLE EXPANSION ENGINE.

The cylinders are $22\frac{1}{2}$, $33\frac{1}{2}$, and $55\frac{5}{8}$ inches in diameter, and are connected to separate cranks on the main shaft at angles of 120°, the stroke being 36 inches, so that at 100 revolutions per minute the engine has a piston speed of 600 feet. The ratio of high to low pressure is 5.625; of the high to the intermediate, 2.16; of the intermediate to low, 2.6.

The end bearings are water jacketed, and the armatures overhung, doing away with the unnecessary extension of the bed plate, reducing the floor space required, and allowing perfect access to the electrical machinery. The armatures weigh 39,000 pounds, and through their action as fly-wheels, in connection with the equidistant arrangement of cranks, insure perfect regularity of motion. The engine is designed for a steam pressure of 160 pounds, and for $12\frac{1}{2}$ expansions at maximum efficiency, in which case the out-

put would be about 1,000 h. p., or 7½ expansions at maximum power, which would be in the neighborhood of 1,500 h. p. The surface condenser is built into the base of the engine, and in the present instance is connected to Worthington independent air and circulating pumps, although the pumps could be worked direct from the crosshead on the back of the columns. The cylinders are steam jacketed throughout, and lagged with magnesia. The engine, including the surface condenser and foundation-box weighs about 320,000 pounds. The total weight of the dynamos is 165,200 pounds, making a total weight for the generator of 485,000 pounds, or six-tenths of a pound per watt. The engine was built by the Southwark Foundry and Machine Co., of Philadelphia, Pa., and the dynamos at the Schenectady works of the company.

The switchboard for controlling the circuits of the 1,000 h. p. generator and those of the four 150 kilowatt bipolar machines that furnish current for the electrical fountains is also shown. It consists of three centre panels with a row of the new Weston illuminated dial voltmeters at the top. Below these come an equal number of dead-beat General Electric Company's ammeters. The lower part of the centre panels is taken up by switches and regulators. The two end panels carry the feeder switches and amperemeters and Howell pressure indicators. The whole is surmounted by a clock in the shape of a miniature multipolar generator.



General Electric Co.'s Main Switchboard in Machinery Hall.

AUSTRIAN DELEGATES TO THE ELECTRICAL CONGRESS.

In response to the invitation extended to it to participate in the Electrical Congress to be held in Chicago, the Electrotechnischer Verein of Vienna has appointed the following of its members delegates to represent it at the meetings: Nikola Tesla, A. Prosch, Inspector of the Austrian State Railways, Ernst Egger, Dr. Johann Sahulka, Constructor at the Imperial High School, Vienna, Fred. W. Tischendörfer, and Joseph Wetzler.

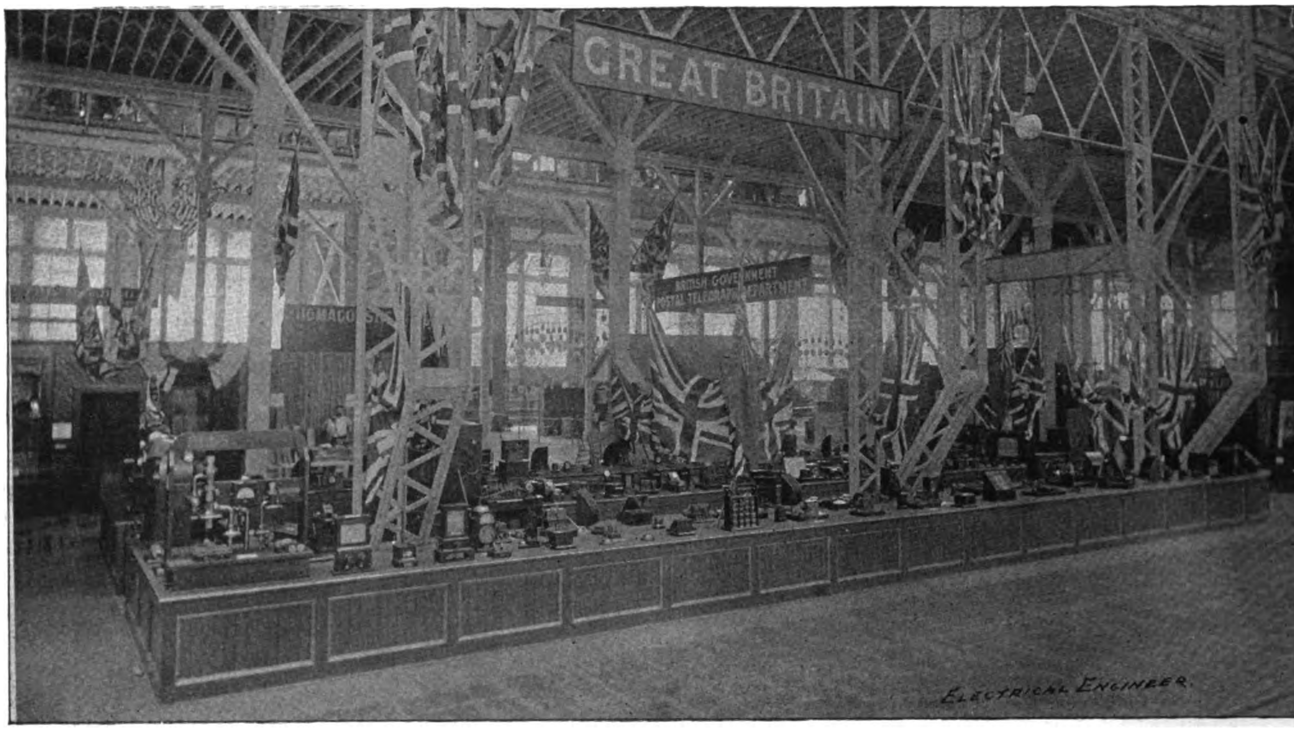
The experimental apparatus of Prof. G. Ferraris, that was thought to have been destroyed by the sinking at its docks of the ship which was to have brought it over, has been recovered and is now on its way here. Prof. Ferraris himself is expected to arrive here on Aug. 5.

THE BRITISH POSTAL TELEGRAPH EXHIBIT.

On the ground floor of the Electricity Bulding occupying the space just west of the Westinghouse transmission exhibit is that of the British Government telegraphic service, under the charge of Mr. John Chapman. The exhibit is largely historical and shows the development of the several systems from their incipiency to the present day; from the earliest Cooke and Wheatstone telegraph 5-needle and dial instrument of 1837, requiring five line wires, to the Delany multiplex, with which six messages may be sent simultaneously over a single wire.

All the systems used by the British Government at present are shown in operation, among them the Hughes type printing telegraph for inter-European traffic; the Wheatstone alphabetical magneto-telegraph for small offices where the extent of business does not warrant the expense of employing the more elaborate instruments and highly skilled operators; the Wheatstone automatic high speed telegraph for press reports, transmitting about 400 words a minute in the Morse code; the British Post Office quadruplex apparatus; and the Morse printing telegraph used for communication between the different government departments where it is desirable to keep records of all messages. The single and duplex telegraphs are also shown together with high speed repeaters for both systems.

The historical exhibit is from the South Kensington Museum of Science and Art and is part of the Postmaster-General's collection there. Here are the original Wheatstone transmitter and receiver of 1840, the earliest Cooke and Wheatstone ticker, made in 1841, and Bain's chemical writing telegraph of 1846. A group of several instruments shows the evolution of the Morse printing system down to the present time, and others show the progress made in train starting and signaling instruments from the earliest forms to Mr. Preece's single wire block signal system now in use throughout Great Britain. Here also is the induction coil used in connection with the first Atlantic cable when the unsuccessful attempt was made to transmit messages by the Whitehouse high tension system. There is a large number of telegraph keys showing improvement in this direction since 1855, and a collection of the earliest measuring instruments, including



THE BRITISH POSTAL TELEGRAPH EXHIBIT AT THE WORLD'S FAIR.

Wheatstone's first resistance coils made in 1838. The Post Office standard Wheatstone bridge for linemen's use is shown near by and forms a striking contrast to its prototype.

Then there are sections of cable, among them, that laid between England and France in 1850, and made by simply encasing the wire in an unarmored rubber insulation about a quarter of an inch thick that gave out after one day's service. This piece lies side by side with a piece of the heaviest armored shore end cable at present in use. An interesting relic is a section of the first five-wire telegraph line between Euston and Camden laid in 1837. This was before the days of insulators or overhead lines, and the wires are embedded in continuous longitudinal slots in a wooden rail buried in the earth and connecting the two stations. After the wires were placed in the slots they were held in place and protected from without by wooden strips driven in against them, and the whole was then soaked in a compound to protect it from moisture. There are samples of early and modern aerial wire joints and insulators from the early glass to the latest double-petticoat porcelain type used almost exclusively in the United Kingdom on account of its freedom from hygroscopic qualities. Old and new forms of relays and lightning protectors, and specimens of batteries complete the historic part of the exhibit.

The system of pneumatic tubes for the rapid transmission of messages between the different telegraph offices is also shown, together with the method of inserting the carriers and receiving them at terminal and way stations, and the block signal system showing whether or not a tube is clear or in use at any moment.

The exhibit is conspicuously situated and profusely and patriotically decorated with English flags, and attracts much attention from visitors to the building, who go away after hearing one of Mr. Chapman's little lectures, feeling quite capable of writing a book on the history and practice of telegraphy in Great Britain. Mr. W. H. Preece, the engineer-in-chief and electrician of the British Postal Telegraphs, is now on his way to this country, and it is to his enterprise and sagacity, largely, that the perfection of the British telegraph service is due.

MECHANICAL ENGINEERS' DAY AT THE FAIR.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, who took part in last week's congress in Chicago were delightfully entertained on Monday, July 31, at the Fair, by Mr. H. F. J. Porter, Assistant Chief of the Department of Machinery, and a member of the society. The many good things offered and indulged in will be seen from the following programme in which, it may be noticed, electricity played an important part:

PROGRAMME.

AFTERNOON.

1.30 o'clock.—Meet at pier, foot of Van Buren street, to take whaleback steamer "Christopher Columbus" to Exposition, through courtesy of World's Fair Steamship Company.

3 o'clock.—Inspection of Multi-Platform Railway, on the pier at Exposition, through courtesy of Pier Movable Sidewalk Company.

3.30 o'clock.—Reception by Engineers of the Exposition, Music Hall, on the pier. Description of engineering features of the Exposition.

5 o'clock.—Reception by representatives of Fried. Krupp in Krupp Pavilion. Inspection of exhibit.

5.30 o'clock.—Reception by the General Electric Company at the power station of the Columbian Intramural Railway. Inspection of large generators and trip over the road.

6.30 o'clock.—Reception by Henry R. Worthington in Pumping Station.

A choice of accepting any of the following invitations for the evening entertainments was given:

EVENING.

First: Trip Around Ferris Wheel, Midway Plaisance, through courtesy of Pittsburgh Construction Company.

Second: Trip over Ice Railway, Midway Plaisance, through courtesy of De La Vergne Refrigerating Mach. Co.

Third: Trip by Boat at 8 o'clock, from pier to two-mile crib, with descent into waterworks tunnel, through courtesy of Messrs. Lydon and Drews, contractors.

Fourth: Exhibition of Horsemanship, etc., at 8 o'clock, in Stock Pavilion, through courtesy of Military Tournament, Limited.

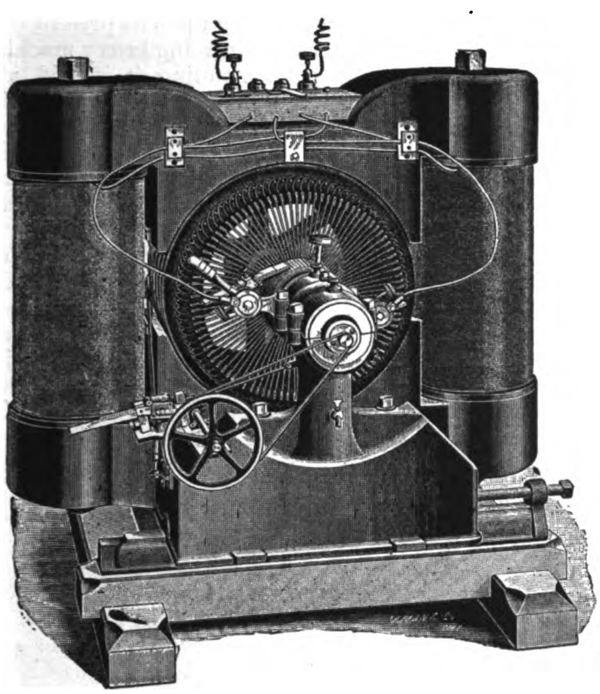
Fifth: Trip in Launches about Lagoons and on the Lake, to view electric illumination and other novelties and the General Electric Co.'s electric fountains which will play from 8.10 to 8.30, 9 to 9.30, and 10 to 10.30 p. m., through courtesy of General Electric Company and Electric Launch and Navigation Company.

Sixth: The Edison Light Tower in the centre of Electricity Building will be illuminated from 8.30 to 9, and from 9.30 to 10 p. m., through courtesy of General Electric Company.

In the Electricity Building during the evening a concert was given by the band of the Associated American Exhibitors, and the great tower of light was flashed in time to the music as at the opening of the building last June. Mr. E. J. Spencer had charge of the musical programme and gave those who accepted the invitations of the General Electric Company no cause to regret their selection.

THE EXHIBIT OF THE STANDARD ELECTRIC COMPANY.

The Standard Electric Company, an engraving of whose exhibit in the Electricity Building is shown on this page, occupy a large space in the northwest section of the hall where they show their generators and lamps. There are six arc machines, one in operation and the others stationary; three machines, respectively of 50, 30 and 20 lights of 2,000 c. p., one of 40, 1,600 c. p. lights and one of 50, 1,200 c. p. lights.



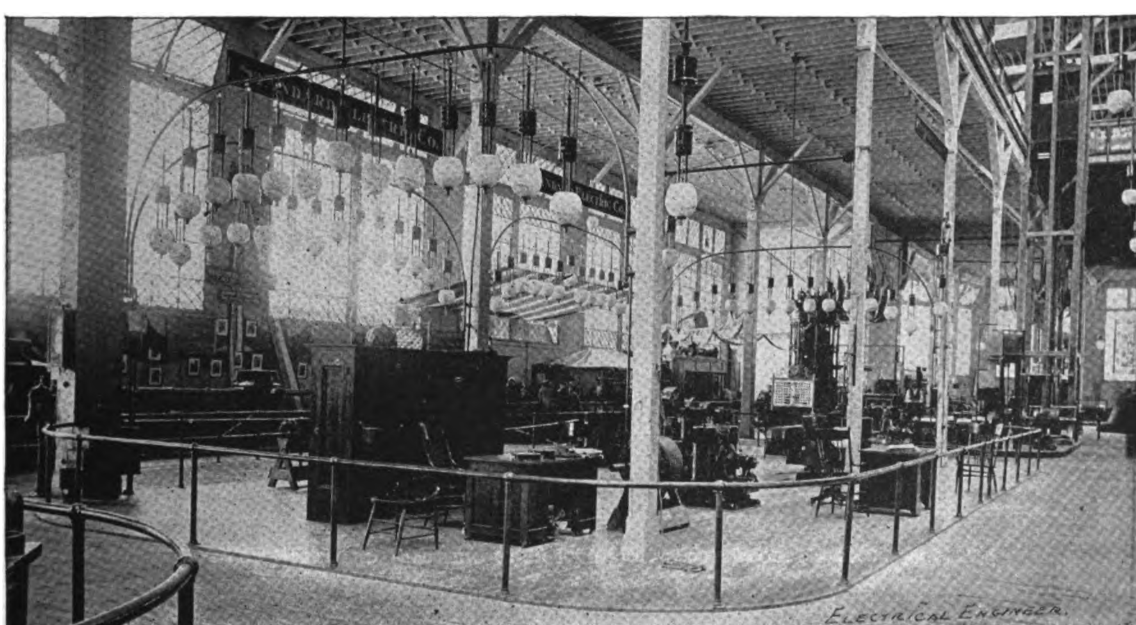
Standard Electric Arc Dynamo.

Current at 500 volts from Machinery Hall runs a 40 h. p. motor built by the Rockford Electric Company, of Rockford, Ill. This is of the iron-clad type running at 1,200 revolutions a minute, and is belted to the largest Standard generator, which operates automatically from short circuit to its full load of 50 lamps.

The automatic mechanical regulating device shifts the brushes rapidly, and is constructed as follows: Between the field poles at one side of the armature is pivotted a piece of Norway iron attached to which is a brass rod connecting with two pawls, one above and the other below a ratchet bar, and so spaced that at the current at which the regulator is set to act both are just out of contact with it. The pawls are given a constant reciprocating motion in opposite directions by the rotation of a shaft belted to that of the armature and running at 80 revolutions a minute, and the ratchet bar is connected at its long end with the brush cradle. As the load on the machine rises or falls, therefore, the Norway iron rod is attracted more or less strongly and by its rotation on its pivot brings one or the other of the pawls into gear with the ratchet bar and shifts the brushes. Six seconds is all the time required to regulate the brushes from a load of one light to fifty lights. The regulator will be clearly understood by referring to the accompanying engraving of the generator.

From the dynamo the current goes to a standard improved plug switchboard for five circuits, and thence to 56 arc lamps of 2,000 c. p., arranged about the space. Besides the lamps, with which all are familiar, are shown mast arms, safety hangers, cut-outs, etc. Armatures, finished and unfinished to show their simple construction and method of winding, are shown, one of them with an open commutator, an air space between each two segments serving as the insulation. Each of these armatures is tested at 3,000 volts before leaving the factory.

The lamps of this company are too well known to require description here. They are shown in all styles; single and double carbon, and for both in-door and out-of-door use. An interesting method of showing the steadiness of the arc has been devised and has attracted much attention. In a cabinet is enclosed a lamp with elliptical double service carbons placed behind a lens that magnifies the arc six times and projects its image upon a screen where it can be observed through holes in the cabinet doors. The visitors to Electricity Building are thus able to study for themselves, without hurting their eyes, the ever interesting phenomena of the electric arc.

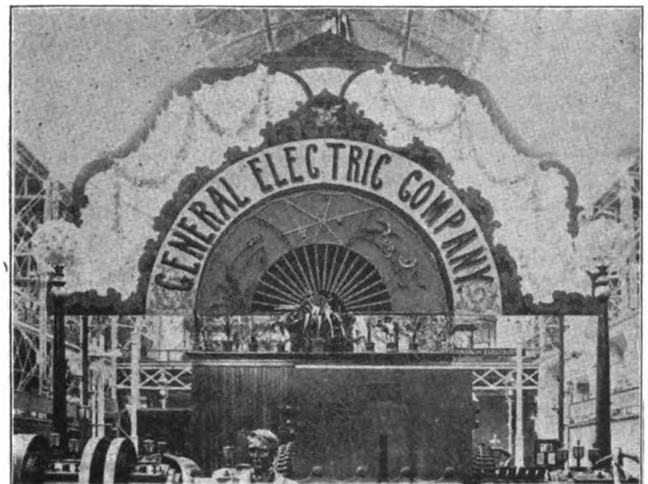


The Standard Electric Co.'s Exhibit at the World's Fair.

THE GENERAL ELECTRIC COMPANY'S FAN.

THE GENERAL ELECTRIC COMPANY have hit upon an unique form of decoration in the shape of a huge fan surmounting the switchboard cabinet in the space devoted to the Edison exhibit. The fan contains 1,276 lamps of one candle-power each, wired up eight in series on a 110-volt circuit and operated by a commutator switch with 22 circuits so arranged that at night the fan seems to open, one stick at a time, until it is fully spread, when it slowly closes again. The spider and fly design above the sticks, on what is supposed to be the body of the fan is connected in sections so that when but two sticks, for instance, are lighted only so much of the fan as corresponds to them becomes visible.

The device attracts considerable attention on illumination nights.



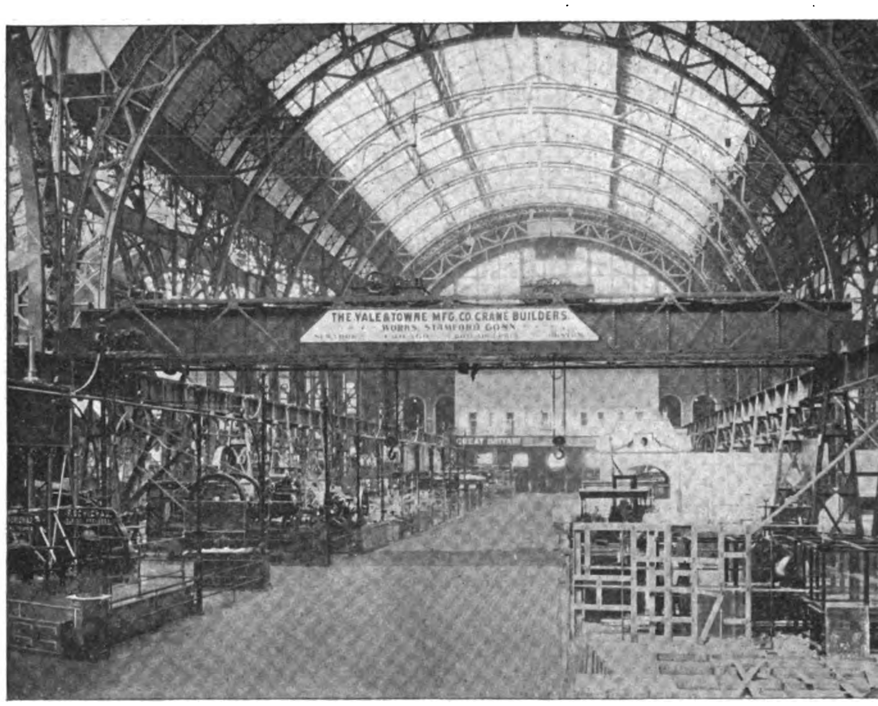
THE ILLUMINATED FAN OF THE GENERAL ELECTRIC CO

THE YALE & TOWNE CRANE IN MACHINERY HALL.

THE great crane traversing the central nave of Machinery Hall and fitted as an observation car from which passengers can get a bird's-eye view of the whole ground floor was built by the Yale & Towne Manufacturing Company, of Stamford, Conn., and before entering upon its present duties did good service in unloading and placing heavy machinery during the installation period, handling, it is said, about two-thirds of all the heavy apparatus in the building. From the 12th of December, 1892, until everything was complete it was steadily at work picking up heavy pieces of exhibits and placing them in their proper positions or as near to the spaces for which they were intended as its area of operation would allow.

The span of the bridge is 75 feet, and it traverses the entire length of the main building and annex, a distance of a little more than 1,400 feet so that the floor space over which its field of usefulness extends is nearly 100,000 square feet after taking out the narrow strip at each side that the trolley cannot cover. The capacity of the crane is rated at 20 tons, though one of the single pieces lifted from the cars and placed in position was a planer bed weighing 70,000 pounds, and it has raised 40 tons without injury.

Five Westinghouse motors are employed for the various operations of moving the crane, hoisting and running the trolleys. The crane motor proper, by which it is propelled is of 20 h. p. and is placed at the centre of the spans, geared with a single reduction of speed to an eight-inch steel shaft decreasing to six inches at the ends, where another reduction of speed takes place as its rotation is transmitted to the wheels. Each of the trolleys has an 8 h. p. motor for hoisting and one of 2 h. p. by which it is moved transversely.



YALE & TOWNE CRANE IN MACHINERY HALL.

Current at 500 volts is taken from one of two trolley wires placed about six inches apart near one of the rails and after traversing the switch board where it is distributed to the several motors controlled by ordinary Westinghouse street railway controlling switches, is returned through the other wire. By this arrangement both current collectors may be supported on the same bracket.

The total weight of the crane is 58 tons and its speed is

about 500 feet a minute. It is now fitted with comfortable seats and completely decked over and affords a delightful means of getting a general idea of the building before entering upon a detailed tour of observation.

THE ELEKTRON EXHIBIT.

The Elektron Manufacturing Company of Springfield, Mass., have made a comprehensive exhibit in the Electricity Building and, in addition, have made life less burdensome to many a weary sightseer by running an elevator from their space near the northwest corner of the building to the gallery above. The machines shown are of the well-known six-pole Perret type, the largest a 15 h. p. 500 volt motor taking current from Machinery Hall, is belted to a 75 ampere, 110 volt dynamo, whence the current is led to a marble switchboard with line switch, rheostat, Queen ammeters and voltmeters, pilot lamps, circuit switches and cut-outs. From here the current goes to four Mosher incandescent arc lamps, several fan motors and to a 1 h. p. motor belted to a Goulds' triplex pump, pumping water into a tank overhead a little faster than it is allowed to escape by a pipe in the bottom. Current is thrown on the motor automatically by a float in the tank connected with a switch and operated at any predetermined level, while a solenoid in the circuit cuts out the resistance slowly and avoids any danger of injury to the motor. When the tank is full the float rises and throws off the switch, stopping the motor and pump until the low water mark is again reached.

A 4 h. p. 500 volt motor is also shown driving a 50 ampere dynamo at present running without load. The resistance boxes for the motor, together with their switches are all mounted together on a pillar close at hand.

The most important part of the exhibit, however, is the elevator mechanism. The motor is a six-pole 500 volt Perret machine of 10 h. p. with a series connection between the armature and commutator permitting the use of only two carbon pencil brushes instead of six and reducing the noise materially. The motor is directly connected to a worm shaft by an universal coupler so arranged that the worm and motor shafts can thrust either way independently. The worm is cut directly on the shaft instead of being sleeved, and the gear is of bronze, hob cut, by Brown & Sharpe, with a ratio of one to forty with the worm, and is bolted to a wide web which, besides being keyed to the drum shaft is bolted directly to the drum as an additional precaution in case of the key working loose.

The elevator hand rope throws in the starting switch and at the same instant releases a brake strap extending four-fifths of the way around a brake wheel on the worm shaft, which is re-applied when the switch is opened to stop the car by the action of a heavy weight at the end of a compound lever. The brake shaft is directly connected to, though insulated from, the switch mechanism, and in neither direction of running is the circuit completed until after the pole changer has been thrown into contact. In the starting rheostat, a flexible connection, independent of the contact bar, is employed to conduct the current to the solenoid, and the resistance is thrown in ready for starting, the instant the circuit is broken. It thus acts as a safety device in case of an accidental break in the line.

It sometimes occurs that an elevator car sticks in the guides, in which case if the car is coming down and the machinery is not stopped, the ropes are apt to become tangled and give trouble. This possibility is also taken into account and provided for by an ingenious and simple device. The hoisting rope as it leaves the drum passes

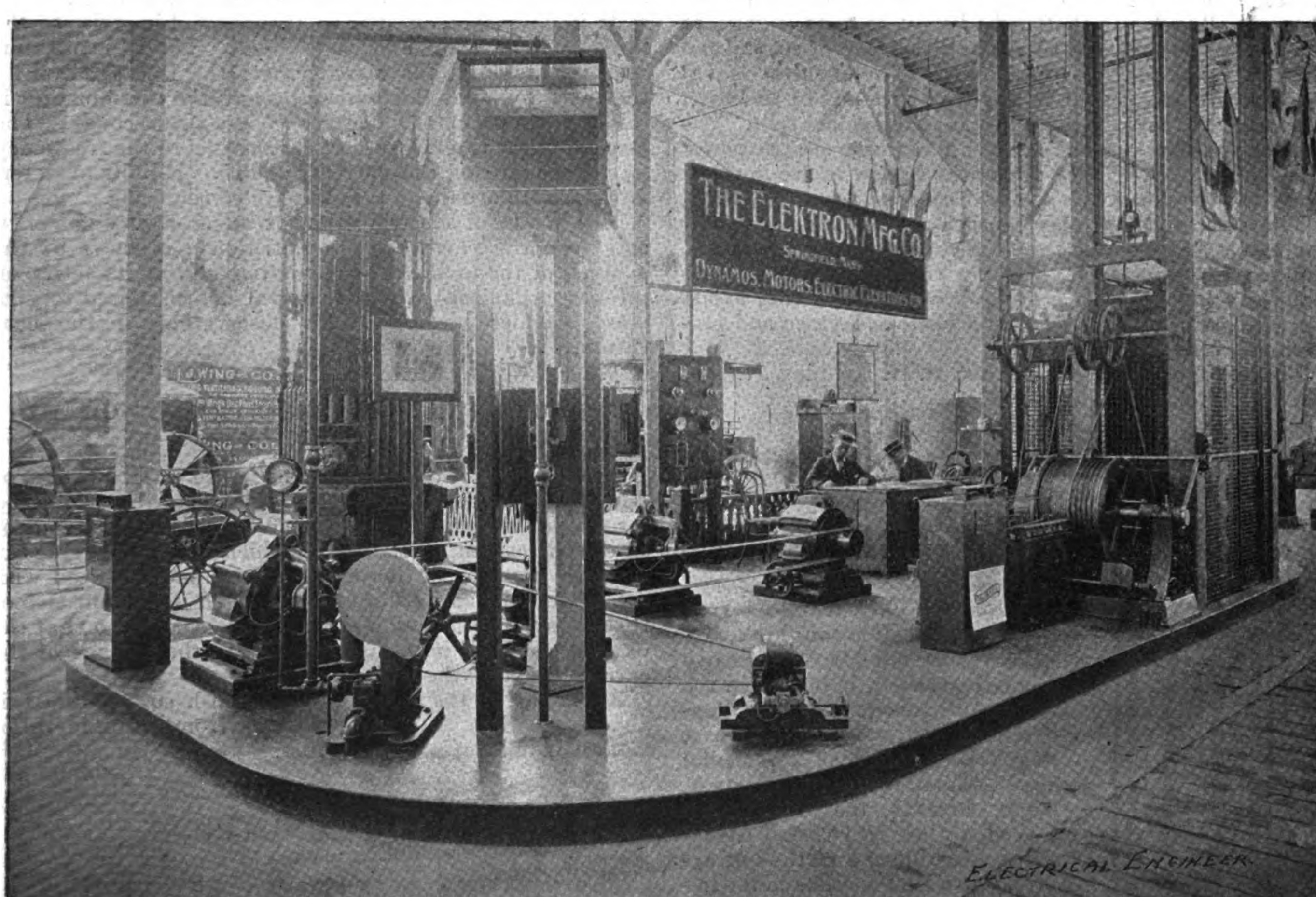


EXHIBIT OF THE ELEKTRON MFG. CO. IN ELECTRICITY BUILDING.

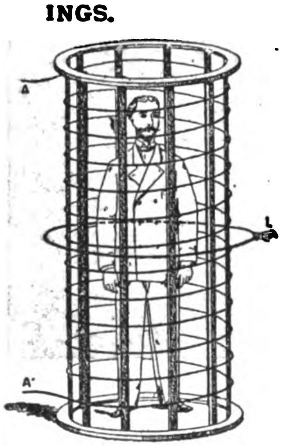
beneath a loose sheave on a frame whose ends are fixed to loose collars surrounding the drum shaft. At the end next the motor is a catch holding back one half of a clutch turning with the shaft capable of sliding along it when released, under the action of a spring-actuated collar. The other half of the clutch is fixed to the motor controlling sheave to which the hand rope is attached. When thus, by reason of the car's sticking on its downward trip, the hoisting ropes become slack, the sheave under which they pass is no longer supported and, with its frame, falls, releasing the movable half of the clutch which immediately unmeshes with that on the controller sheave and cuts out the motor. To guard against "racing," there are two weights inside the drum acting like governor balls, and when the speed becomes too great, releasing a heavy weight that sets a hand brake and brings the drum to rest. As an additional safeguard against accident from allowing the car to go too far in either direction a traveling nut on the controller sheave shaft may be set so as to engage, at the desired instant, a fixed nut at either end of its rim and automatically cut out the motor. The rheostat is not mechanically connected in any way with any of the other apparatus and may be placed in any convenient spot. The company has had much experience in adapting electric power to elevator work. Their apparatus is now in use in many cities and the demand is said to be increasing.

The rest of the display consists of small motors, motor generators for changing from direct to alternating currents, and parts of apparatus, showing their construction. As almost all the machines are shown in operation they excite a great deal of interest from the visitors, laymen and professionals alike.

The exhibit is in charge of Mr. M. H. Robbins, Jr., and Mr. H. Cochrane.

MISCELLANEOUS.

D'ARSONVAL'S METHOD OF AUTOCONDUCTION, A NEW METHOD OF ELECTRIFYING LIVING BEINGS.



Among the phenomena observed in the application of high frequency currents Mr. Tesla early pointed out their influence on the human organism, and even suggested several ways in which it might be applied as a remedial agent. In studying the effects of such currents the well-known French authority, Dr. A. d'Arsonval, has designed a method of applying it which consists in the immersing of the subject to be treated entirely, or in part, in the oscillating magnetic field of high frequency.

The way in which this is carried out is illustrated in the accompanying engraving. The subject to be treated is placed in a cylinder of insulating material, such as hard wood or glass, and the cylinder wound with one or more layers of electric light cable; this constitutes a sort of solenoid in the interior of which the subject is placed. The coil is traversed by the discharge of the condenser rendered oscillatory in the manner described by Dr. d'Arsonval before the Physical Society of Paris last year. He employs as a condenser from two to 12 Leyden jars, arranged in two batteries joined in cascade, each jar having a metal surface 50 centimetres high and 20 centimetres in diameter. The charging is accomplished by a 15,000-volt transformer from a Siemens alternator without iron and having a capacity of 12 amperes at 350 volts. The Siemens alternator gives 60 amperes per second.

Under these conditions the induction effects of the coil on all bodies plunged in its core are of the most striking nature. Thus if within the coil consisting of only three or four turns of a cable having 10 strands of wire equal in cross-section to eight sq. mm. there be inserted a copper wire which has a single turn to which a 100 candle lamp is attached and requiring three amperes at 110 volts, the lamp is brought to a white incandescence. If a man embraces the coil, as it were, and holds in each hand the terminals of an incandescent lamp the circuit so formed by his arms is the seat of an induced current sufficiently powerful to light the lamp which takes $\frac{1}{10}$ of an ampere. The resistance of the skin is reduced as much as possible by plunging the hands in two vessels containing warm salt water.

In order to measure the strength of magnetic fields of such high frequency Dr. d'Arsonval makes use of Foucault current effects. His method of applying them consists in the employment of a mercury thermometer which he inserts in a smaller auxiliary coil connected in series to the large one which contains the subject. The Foucault currents generated in the mercury heat the latter so rapidly that with four jars the temperature of the thermometer is raised more than 150 degrees C. in a few seconds. The heating effect is a measure of the product of the frequency by the square of the current, and thus permits of determining, with accuracy, the strength of the fields.

This mode of electrification exercises a very powerful action on the phenomena of nutrition as is shown by the analysis of the products of respiration and by its action on inferior organism. Dr. d'Arsonval has promised to give more complete details of his observations in the near future.

PRODUCING VARNISH FROM LINSEED OIL BY ELECTRICITY.

Among the recent patents is one issued to H. Pfanne, of Rixdorf, near Berlin, Germany, which describes a method for the production of varnish from linseed oil by means of an electric current. Linseed oil which has been purified in a proper manner, is thoroughly mixed and agitated with sulphuric acid and water and subjected for about two or three hours to the action of an electric current so that the oxygen produced in the nascent state by the passage of the current converts the oil into varnish.

According to the inventor, the varnish so produced is almost colorless and perfectly free from all mineral or metallic admixtures or impurities.

LEGAL NOTES.

GENERAL ELECTRIC COMPANY'S RAILWAY SUITS.

The Sprague Electric Railroad and Motor Company of New York has filed a bill of complaint against the Winchester Avenue Railroad Company of New Haven for infringement of its improvements in electric railways. An injunction is prayed for. Betts, Atterbury, Hyde & Betts of New York, are counsel for complainants. The bill is returnable on the September rule day. The suit is, of course, in reality, brought by the General Electric Company. The road in the case is using Westinghouse apparatus.

PERSONAL.

Mr. John M. Baker has been appointed superintendent for the Central Union Telephone Company for the State of Indiana, dating from August 1, 1893, vice Mr. C. F. Barnes, transferred. Mr. Baker's office will be in Indianapolis, Indiana.

Mr. Federico Klein has just been appointed chief engineer of the two electric light companies at Sonsonate and Santa Ana, Republic of Salvador, Central America.

Dr. Johann Sahulka, of the Technical High School, of Vienna, has just arrived, and will proceed to Chicago to attend the Electrical Congress.

ELECTRIC RAILWAY DEPARTMENT.

THE ELECTRIC RAILWAYS OF THE PACIFIC COAST.

In order to obtain accurate data on the condition of the electric railways on the Pacific coast, Mr. C. Hewitt, of the Railway Department of the General Electric Co., was delegated to make a tour of inspection with that end in view, and the results of his trip, just concluded, are embodied in a report made by him to Mr. O. T. Crosby, general manager of the Railway Department. We print below an abstract of this report which has been kindly placed at our disposal:

Metropolitan Railway, San Francisco.—This road has four miles double track, and 15 single truck cars equipped with two W. P. 50 motors. The service on this road is very severe indeed. The grades are numerous and very heavy, reaching 13¼ per cent. The motors are well cared for, and consequently are giving great satisfaction. An experiment is about to be tried on this road using the motors as brakes for descending the steep grades. They first tried simply short circuiting the motors, but with this arrangement the car ran too slow. When I left they were fitting a car up so as to short circuit through a rheostat. Three M. P. 90 generators are used in the station and are working very satisfactorily.

San Francisco and San Mateo Railway.—This road has nine miles of single track and 4.19 miles of double track. The station is equipped with six M. P. 80 and two M. P. 90 generators. There are 17 single truck and 15 double truck cars. Fifteen cars have S. R. G. 30 equipments and 17 have W. P. 50 equipments; all with rheostat control. This road has been unfortunate in its financial affairs, which may account for the bad condition of the apparatus, more particularly the motors. Axle brasses have been taken from these motors that were not only worn clean through, but the axle had cut nearly a half inch into the iron. Under such circumstances it is a wonder that the motors have run as well as they have.

The following roads may be treated together, as the general conditions are very similar:

Oakland Railway.—.65 mile single track and 5¼ miles double track; three M. P. 90 generators; 18 single truck cars with W. P. 30 equipment.

Oakland Consolidated Railway.—8.8 miles single track and 3.4 miles double track; four 80 K. W. Edison generators; nine single truck cars with single W. P. 30 equipments; 16 double truck cars with two W. P. 30 motors.

Consolidated Piedmont Cable Railway.—2.3 miles double track; two M. P. 90 generators; nine single truck cars, eight of which have one W. P. 30 motor, and one has two W. P. 30 motors.

East Oakland Railway.—2.7 miles single track; 1.75 miles double track; three M. P. 90 generators; 18 single truck cars, six of which have one W. P. 30 motor, and seven have two W. P. 30 motors.

Highland Park and Fruitvale Railway.—5.12 miles of single track; five single truck cars with W. P. 30 equipments. This road rents its power.

Oakland, San Leandro and Haywards Electric Railway.—11.48 miles of single track and 4.85 miles of double track; two M. P. 80 generators and one M. P. 300; 20 single truck cars with one W. P. 50 motor; five double truck cars with two W. P. 50 motors. All but nine of these have nine turn armatures.

Oakland, Alameda & Piedmont Railway.—3.48 miles single track and 1.72 miles double track; two M. P. 100 generators; eight double truck cars with W. P. 30 equipments.

Santa Cruz Electric Railway.—4.25 miles single track; two M. P. 90 generators; seven double truck cars with W. P. 30 equipments.

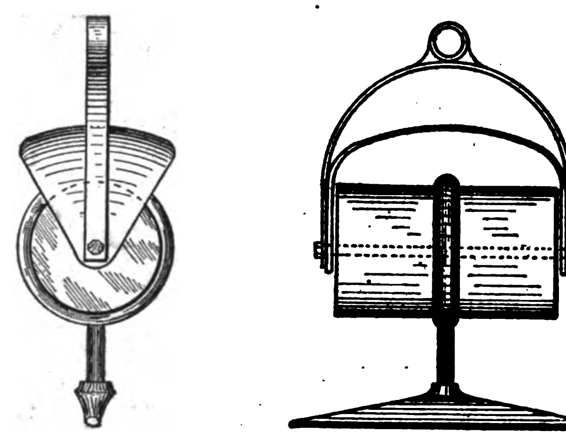
First Street Railway, San Jose.—7.93 miles single track; 2.49 miles double track; two D-62 generators; 17 single truck cars, five of which have one S. R. G. 30 motor each, and 12 have one W. P. 30 each.

San Jose and Santa Clara.—5.5 miles single track; 5 miles double track; one D-62 generator and one 80 K. W. Edison generator; nine single truck cars and four double truck cars; three of these have Edison No. 14 motors, the remainder have S. R. G. 30 motors.

These roads, and especially those in Oakland, are in exceptionally good condition. On some of those equipped with the W. P. motors, burnt out armatures are entirely unknown, and cripples from any causes are very rare. The little troubles which have caused so much annoyance on our eastern roads do not seem to have bothered these roads at all. The secret of these good results undoubtedly lies in the fact that no car is allowed to run longer than four weeks without being overhauled. Those roads which have only a few cars, overhaul them as often as every two weeks. If the barn is properly equipped, one good man and a helper can overhaul one pair of motors a day. Thus two men can take care of 25 cars and have time for repairs to trucks and brakes, and every car can receive an overhauling once a month. In addition, the cars get the usual cleaning and inspection at night. It seems odd that more of our eastern roads do not adopt this method of operation, as it certainly is the easier and cheaper method. These roads have all experienced the usual troubles with gear cases, loose sleeves and collars on armature shafts, etc., but the regular overhauling has prevented any serious trouble.

Complaint was made of the Alameda cars that in case of delay they were unable to make up time. To overcome this, our district engineer Mr. Lighthipe, placed a 3 ohm shunt around the field coils, connecting it through a snap switch. The motormen understand that this is to be used only in case of delay. The use of this shunt I was told increased the current through the armature about 5 amperes and increased the speed about five miles per hour.

The Oakland, San Leandro & Haywards road is particularly interesting on account of its apparent good management, and the speed which the cars make. The distance from Oakland to Haywards is fifteen miles, and the distance has been made, I believe, is thirty-five minutes. These cars attain a speed of at least thirty-five miles per hour, and some make a daily average of over two hundred miles per day. One of these cars is equipped with the Genet air brake. It also has an air whistle. This brake has not been in use very long, but up to the time of my visit it had proved very satisfactory.



A Trolley Hanger Used in Seattle, Wash.

The only other roads in California are at Sacramento, Stockton, San Diego and Los Angeles. I did not visit these roads but I learned that almost no trouble is experienced. All these roads are equipped with General Electric Company's apparatus, except the Los Angeles roads.

Portland, Oregon.—There are three roads in Portland. 1. The East Side Railway. This road runs from Portland to Oregon City, a distance of 12 miles. It is equipped mostly with No. 16 Edison motors. I was unable to find the superintendent, but from all I could gather from the men at the barn, these motors seem to be doing very good work, although I noticed several armatures being repaired. An interesting feature of this road is the fact that current is carried to a distance of nine miles from the station. The generators are run at 600 volts.

2. The City and Suburban Railway operates about 50 cars, four of which have Westinghouse motors, and the remainder are chiefly W. P. motors. The motors are well cared for and but little trouble is experienced.

3. The Portland Consolidated Railway is equipped with Sprague No. 8 and Edison No. 14 motors. There are also ten new W. P. 30 equipments. I heard no complaint of any of these motors. Of course the well known troubles with the older types of motors are experienced here as elsewhere, the actual amount depending on the care which the machines receive. Considerable trouble was experienced last winter by all the roads in this vicinity on account of the unusual snow fall.

Tacoma, Wash.—This road was equipped originally with No. 6 Sprague motors. These have mostly been set aside and 18 cars now have W. P. 50 equipments and ten cars have W. P. 30 motors. There are three No. 8 and one No. 6 equipments still in use. This road has suffered considerably in all departments from neglect.

There seems to have been no regularity at all about the care of the motors, and consequently they are not in the very best condition. An effort is being made to correct some of these difficulties, but at the present time the whole road is in poor condition.

The Point Defiance, Tacoma and Edison Railway operates six cars with two No. 14 Edison motors, three cars with W. P. 30 and one car with W. P. 50 motors. The No. 14 motors are used outside the city where they make but few stops. Under these conditions they work very well. All the motors seem to be satisfactory.

Seattle.—The Seattle Consolidated Railway has seven Westinghouse equipments, three F-30 and ten W. P. 30 equipments. I noted four Westinghouse armatures in the repair shop and two W. P. armatures. The latter had been hit.

The West Street and North End Railway Company had originally 14 equipments, but at present there are only eight complete F-30 equipments and one F-40. Various parts of the other equipments are lying about the barn. I found ten F-30 cores and one F-40 core in the shop. The road has been unprofitable from the beginning and has literally been run into the ground. They have changed superintendents lately and the new superintendent is endeavoring to put the apparatus in better shape.

The Union Trunk Line has 15 W. P. 30 equipments and one No. 14 Edison. They claim that the W. P. 30's are not powerful enough for their work. On the Lake Washington Line there is a grade of about eight per cent, for nearly a mile and part of this is on a long curve. With a large party of excursionists the W. P. 30's must certainly be heavily taxed. Still, if they should adopt the plan of regular overhauling, they would prevent much of their trouble. I noted six W. P. 30 armatures and one No. 14 in the shop.

The Ranier Avenue Electric Railway have only four F-30 equipments, which seem to answer their needs. This road has a grade of 16.85 per cent. on which they use a counter weight very successfully. The rope with the counterweight travels in a conduit between the rails. The road is a single track and each descending car draws the counterweight to the top, and each ascending car lowers the counterweight. In this way the car is assisted in ascending, and a safety device is provided while descending.[1]

The Grant Street Railway have ten single W. P. 30 equipments. They have a power house of their own, but find it cheaper to rent power from the Consolidated Railway. Two men keep these cars in repair. The motors are overhauled regularly about once a week, and consequently they are in good condition. One W. P. armature was in the shop with a burnt out section. The line work on this road is constructed with hangers of local make, shown in the accompanying rough sketch. (See page 139.)

I also stopped at Spokane Falls, where I found in use F-20, F-30, No. 8. W. P. 30, W. P. 50 and Short motors. The cars are not overhauled regularly, and four men are kept busy on repairs. Most of these repairs, however, are due to the old types of motors. I found in the shop five F-20 armatures, nine No. 8 and one W. P. This latter had grounded on the core.

All these roads except at Portland have been largely built in anticipation of the population, and it is impossible that they can be paying. This may account for the neglected condition of the motors.

1. For a description and illustration of this arrangement see THE ELECTRICAL ENGINEER, July 12, 1893.

ELECTRIC WELDING OF RAIL JOINTS.[1]

AT the meeting of the American Street Railway Association, held at Cleveland last October, Mr. A. J. Moxham, president of the Johnson Co., presented a paper[2] which attracted a good deal of attention, in which he reported the results of experiments made at Johnstown, Pa., with very long rails. These experiments carried out with rails joined solidly and held by heavy fish plates demonstrated that for street rails buried in the ground, expansion could be neglected. Subsequently the Johnson Company built 3,000 feet of track in Johnstown, Pa., the joints of which they welded up solid, and although the track has been subject to a range of temperature of 80 degrees, no linear or lateral motion has been observed. This track was built last May, the welds being made with a specially designed welder built by the Thomson Electric Welding Company at Lynn, Mass., and referred to in an interesting letter by Mr. Hermann Lemp, electrician of the company, which appeared in our issue of April 26, 1893.

With this encouragement the company has obtained a contract from the West End Street Railway of Boston to weld together 16 miles of track in Cambridge, and is now engaged in the execution of that contract, the welding machinery being of the Thomson Electric Welding Company's make. The track has been laid, and in constant use for about two years, and the welding is now being done without disturbing the track or paving except to remove a few paving blocks at the rail joint. The rail is a heavy girder rail about eight inches deep.

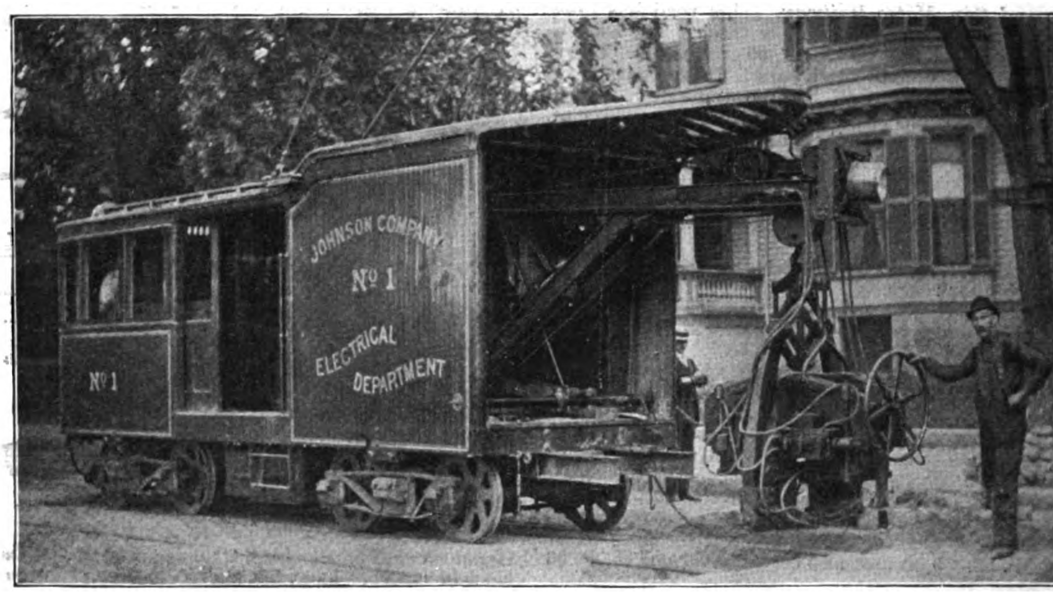


FIG. 1.—ELECTRIC RAIL WELDING CAR ON WEST END RAILWAY, BOSTON.

The old fish plates are first removed, and the ends of the rails freed from rust and scale by a hand emery wheel on a flexible shaft and operated by an electric motor. A thin piece of steel of the same shape as the rail section is driven tightly between the rail ends to insure contact. Then the joint is ready for welding, which operation can be best explained by describing the welding machine.

Fig. 1 shows a general view of the car which contains the whole welding plant, and Fig. 2 the welding machine itself at the moment a weld is being made. The current necessary to the operation of the car and plant is taken from the trolley wire over the track. This current is employed directly to propel the car, to operate the derrick by which the welding machine is moved, to run the emery wheels before mentioned, and to actuate a large dynamotor inside the car.

This machine takes the 500-volt direct current of the trolley wire and converts it into an alternating current of 300 volts potential. This alternating current is in turn conducted into a transformer shown at T, Fig. 2, which reconverts it into a current estimated at 4 volts and 40,000 amperes.

This current is then conducted from the transformer T, Fig. 2, through a thousand strips of copper shown at A, to the secondary poles S S and through the fish plates and the web of the rail. The

1. *Railroad Gazette.* 2. See THE ELECTRICAL ENGINEER, Oct. 26, 1892.

fessing of this great current through the plates and rail causes heating sufficient to produce a white welding heat in two or three minutes, seen at W, Fig. 2. The poles in contact with the white-hot fish plates are kept cool by a jacketing of water circulated through the pipes H. When a welding heat is obtained the pressure is applied by a few revolutions of the hand wheel, Fig. 2, and the fish plates are forced against and cemented to the web of the rail. This pressure is accomplished by a system of levers, clearly shown in Fig. 2. The poles of the transformer S S', the tie plate W, and the web of the rail are between the lever jaws. By such an arrangement of levers and screws, a small force applied to the hand wheel exerts a pressure of 40,000 pounds at the weld. Under this pressure a perfect union of the pieces is obtained and the welding completed. The current is then cut out, the machine of Fig. 2 is lifted by the electric derrick, as shown in Fig. 1, and the operation is repeated at another joint.

A few points deserve special notice: It should be made clear that the rails themselves are not welded together, each to each, but that the adjacent rails are welded to the same pair of fish plates. Each rail is welded separately, it requiring two welding operations at every joint. The fish plates are quite unlike the usual form employed in railroad construction. They are 4x7 inches

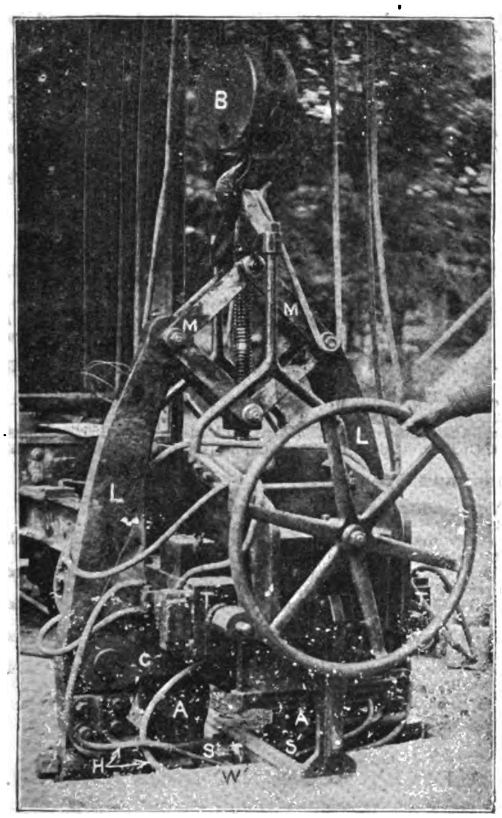


FIG. 2.—ELECTRIC RAIL WELDING MACHINE.

by 1 inch thick, with a ⅝ inch lug running the width of the plate. This lug is flattened down under the pressure and affords materials for the weld. If, when the weld is made and it is still red hot, the track is not quite straight and true, a few blows with a sledge will bring the rails into their correct position. Rail joints thus welded do not require to be bonded to insure the passage of an electric current.

ELECTRIC LIGHTING AT TROY, N. Y.

THE electric light department of the Troy Gas Company has made a notable change under its present superintendent, Mr. John F. Cahill. One continuous line of shafting resting upon solid brick and stone foundations runs through the centre of the works. This, with friction clutches at stated intervals, enables the lights to be thrown on at the proper time as power is needed. The last of the old engines has been thrown into the scrap pile and the entire works are now operated by the power from the small double engine during the day time, shifting to the larger Corliss compound as the load increases towards night, and finally throwing the whole load, through the night, upon the 500 h. p. compound Corliss, recently put in. This, as far as experience goes, appears to be the economical way of disbursing power, as the big Corliss is capable of working economically up to a far higher degree than its rated capacity.

OBITUARY.

JOHN STEPHENSON.

John Stephenson.

JOHN STEPHENSON, the famous car builder, died on July 31 at New Rochelle, N. Y., of old age. He was eighty-four years old, and had no particular ailment. Mr. Stephenson was born in County Armagh, Ireland, on July 4, 1809. The family settled in New York in 1811. After a course at the Wesleyan Seminary, this city, he was apprenticed to a coachmaker in Broome street.

During the first two years of young Stephenson's apprenticeship to Andrew Wade of 347 Broome street he spent his evenings drawing and designing. Abram Brower, a liveryman at 661 Broadway, the pioneer of the Broadway omnibus lines, had for four years run "accommodation vehicles" from the corner of Broadway and Bleecker street to Wall street, fare one shilling. His carriages were repaired at Andrew Wade's by young Stephenson.

In 1831, after his apprenticeship was completed, Mr. Brower invited Mr. Stephenson to open a shop at 667 Broadway. On May 1, 1831, Mr. Stephenson began business there on his own account. Then he designed the first vehicle known in New York as an "omnibus," which was quickely followed by the "Minerva," the "Mentor," the "Forget-me-not," and others. On the 29th of the following March his shop and all his stock were destroyed by fire. Then he started again at 264 Elizabeth street.

Mr. Stephenson had a growing omnibus trade, but the New York and Harlem Railroad, which was chartered on April 25, 1831, presented a new field for the exercise of his skill. This, the first of street railroads, confined by its charter to the corporate limits of the city, had for its president John Mason of the Chemical Bank. The business and passenger office was on the east side of the Bowery, two doors below Stanton street. The company arranged with Mr. Stephenson to construct a car of entirely new design. The Stephenson car, "John Mason," named after the president of the road, has become historical as the first street car ever used. On Nov. 26, 1832, the road was opened from Prince street to Fourteenth street. On its first trip the car carried the mayor and common council of the city. Mr. Stephenson received a patent on the car, now in possession of his family, signed by Andrew Jackson, President of the United States, and by members of his cabinet. Other orders from the same company followed, and in three years orders were received from Paterson, Brooklyn, Jamaica, N. Y., and from Cuba and Florida.

His business continued to extend, and his cars were sent to many foreign countries. The factory in East Twenty-seventh street now employs 500 men. During the war he did good service, building many pontoons and gun carriages. Mr. Stephenson was regarded as a man of unflinching honesty, and at one time when he failed he refused to take advantage of the Bankruptcy Law, ultimately paying up every cent in full. About twenty-seven years ago he made his home at "Clifford," New Rochelle. In 1833 he married Julia A. Tiemann. He leaves two sons and a daughter.

ON THE TRANSPARENCE OF EBONITE.

SIGNOR RICCARDO ARNÒ has been further carrying out the lines of research undertaken by Profs. Ayrton and Perry, by Abney, Festing, Preece and J. J. Thomson, and has arrived at certain very interesting results. He concludes from his experiments that ebonite in thin leaves is not transparent in the same degree for all the radiations of obscure heat. It is so much more transparent for such radiations the more they are refrangible, and, in the highest degree, for those of the shortest wave length. Its diathermanous power is greatest when the source of heat is one from which there emanate thermic radiations of small wave length. It is known that if the leaves of ebonite are thin enough it is transparent, also for the visible radiations which are less refrangible. Ebonite in thin leaves arrests the radiations of obscure heat so much the more easily the less they are refrangible. As with the other substances, the diathermanous power of a leaf of ebonite increases with the degree of brightness of its surface and diminishes with its thickness.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 18, 1893.

Accumulators:—

Secondary Battery, F. King, London, England, 501,728. Filed March 16 1893.
Claim follows:
A plate for secondary batteries having projections extending out from the surface thereof, and combined with continuous strips of insulating and acid resisting material placed over said projections.

Alarms and Signals:—

Electric Circuit Connection for Signaling or Telephone Boxes, J. E. Smith, New York, N. Y., 501,631. Filed Feb. 24, 1893.
Especially adapted to fire-alarm service.
Automatic Fire Alarm, J. Havard, New Bedford, Mass., 501,653. Filed May 10, 1893.
A thermostatic device.
Burglar Alarm, C. J. Fisher, Chicago, Ill., 501,777. Filed April 5, 1893.
Electric Fire Alarm, C. Bernhardt, Chicago, Ill., 501,905. Filed October 3, 1893.
A thermostatic system.

Dynamos and Motors:—

Device for Regulating Constant Current Dynamo Electric Machines, O. Offrell, Middletown, Conn., 501,532. Filed Dec. 12, 1892.
Employs a magnetic shunt or shield arranged to be interposed between the armature and pole pieces.
Electric Motor, M. W. Long, Harrisburg, Pa., 501,842. Filed March 23, 1891.
A "step-by-step" motor operative by either a continuous or an alternating current.

Electrolysis:—

Method of Manufacturing Varnish and Apparatus Therefor, H. Pfanne, Rixdorf, Germany, 501,578. Filed Aug. 29. 1892.
Produces varnish by the passage of an electric current through a mixture of linseed oil and acidulated water. The fluid may be kept in constant agitation by rotary motion or otherwise.
Apparatus for Depolarizing in Electrolysis, J. C. Richardson, London, England, 501,628. Filed Jan. 26, 1893.
Employs a movable cathode arranged to carry depolarizing material and provided with means for advancing it through the tank, and means for delivering and removing the depolarizing material.
Method of and Apparatus for Purifying Water, H. Roeske, Philadelphia, Pa., 501,732. Filed Oct. 15, 1892.
Consists in passing the water through a stratum or body composed of pieces of iron which is simultaneously agitated and subjected to the action of an electric current. The water is then filtered to remove impurities not precipitated by the oxide disengaged from the iron. The filtrate is finally aerated.
Method of and Apparatus for Electrolyzing Solutions, E. Hermite, Paris, France, and A. Dubosc, Rouen, France, 501,783. Filed July 9, 1892.
For obtaining alkali or alkaline earth metal bases or compounds by the electrolysis of saline solutions.

Ignition:—

Gas Lighting Apparatus, G. Göridt, Kissingen, Germany, 501,565. Filed Dec. 10, 1892.

Lamps and Appurtenances:—

Incandescent Lamp Socket, H. P. Ball, Schenectady, N. Y., 501,485. Filed Aug. 3, 1892.
Incandescent Electric Lamp, E. E. Cary, Boston, Mass., 501,491. Filed April 6, 1893.
For a cement stopper lamp. Devised for preventing conduction of heat by the leading-in wires to the cement.
Incandescent Lamp Fixture, A. T. Gifford, Hopedale, Mass., 501,502. Filed Nov. 28, 1890.
Surgical Lamp, W. G. Morgan, Fryeburg, Me., 501,524. Filed July 27, 1892.
Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., and E. E. Cary, Boston, Mass., 501,529. Filed March 29, 1892.
Employs, in a stopper lamp, a non-conducting flexible disc of laminated structure and glass-like reflecting surface to support a fusible plug.
Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., and E. E. Cary, Boston, Mass., 501,530. Filed March 31, 1893.
A stopper lamp. Sealing of fusible cement consisting of rosin chemically combined with lime and a suitable oil.
Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 501,531. Filed Apr. 6, 1893.
A stopper lamp. Fusible cement composed of materials freed from volatile matter by exposure to a reduced atmospheric pressure at a high temperature.
Electric Lamp Socket, G. Sachs, St. Louis, Mo., 501,580. Filed Apr. 27, 1893.
Electric Arc Lamp, S. Bergmann, New York, N. Y., 501,757. Filed Jan. 10, 1893.
Regulating mechanism.
Carbon Holder for Electric Arc Lamps, S. Bergmann, New York, N. Y., 501,758. Filed March 20, 1893.
Electric Arc Lamp, J. T. Dempster, Summit, N. J., 501,768. Filed Feb. 13, 1893.
Provides automatic means for switching the shunt magnets out of circuit when the carbons have ceased burning.
Electric Arc Lamp, W. H. Klees, Susquehanna, Pa., 501,884. Filed June 10, 1892.
Designed to obviate the usual shadow under an arc lamp. Employs arc-shaped carbons projecting, and forming the electric arc, below the base of the lamp.

Measurement:—

Electrical Measuring Instruments, R. M. Hunter, Philadelphia, Pa., 501,589. Filed Feb. 10, 1893.
Employs an expansion wire to actuate a pointer.

Medical and Surgical:—

Electric Body Battery, H. C. Wagner, Cleveland, O., 501,550. Filed Sept. 1, 1892.
Electro Medical Apparatus, J. A. Cabot, Cincinnati, O., 501,558. Filed Aug. 24, 1892.
Electric Belt, B. H. Standish, Evansville, Wis., 501,849. Filed Oct. 24, 1892.
Electric Belt, A. D. Berliner, Rock Island, Ill., 501,861. Filed June 23, 1892.

Metal Working:—

Automatic Chain Welding Machine, E. Thomson, Swampscott, Mass., and C. E. Harthan, Lynn, Mass., 501,546. Filed Jan. 8, 1891.
Relates to the operations of feeding the material, heating it and subjecting it to the desired mechanical action, the operations being in whole or part automatic. A step-by-step, or intermittent feeder is employed.
Claim 90 follows:
In an electric metal-working machine, the combination with the mechanism which operates upon the softened metal, of a source of heating electric currents, and a current controller connected with said mechanism and operated thereby automatically to apply the heating current intermittently to successive portions of the work.
Shaping and Spinning Metals by Electricity, E. Thomson, Swampscott, Mass., 501,547. Filed Jan. 8, 1891.
Applies the electric current to soften the work.
Method of Forming Coal Cutters, F. Bain, Chicago, Ill., 501,755. Filed May 31, 1892.
Imbeds an iridium point in a tool-body of iron, steel or other metal. Includes the parts within an electric circuit, pressing the iridium into a recess in the tool body while hot and plastic.
Method of and Apparatus for Heating, Welding or Working Metals Electrically, C. L. Coffin, Detroit, Mich., 501,825. Filed Feb. 9, 1893.
Springs a voltaic arc between two electrodes, one within the other, rotates the arc magnetically, and applies the arc to the article to be heated.

Miscellaneous:—

Method of an Apparatus for Extinguishing Fires, J. G. Lorrain, London, England, 501,519. Filed March 18, 1892.
Employs fusible connections of conducting material which are melted on the passage of a current, thus releasing valves of water pipes or sprinklers.
Electrical Musical Instrument, P. E. Singer, London, England, 501,540. Filed June 16, 1892.
Electrical Musical Instrument, P. E. Singer, London, England, 501,541. Filed June 16, 1892.
Electrical Musical Instrument, P. E. Singer, London, England, 501,542. Filed June 17, 1892.
Electrical Musical Instrument, P. E. Singer, London, England, 501,543. Filed Feb. 21, 1893.
The above four inventions are applicable to keyed musical instruments, such as the pianoforte, in which vibrating bodies produce the tones. Means are provided for initiating or prolonging the tones by the closing of an electric circuit.
Electric Switch, W. H. Dingle and J. M. Urquhart, London, England, 501,707. Filed April 23, 1892.
Lightning Arrester, F. H. Doane, New York, N. Y., 501,706. Filed May 31, 1893.
An electro-magnetic device.

Railways and Appliances:—

Regulating Electric Locomotives, J. B. Blood, Lynn, Mass., 501,488. Filed Nov. 16, 1892.
Employs several motors of varying counter-E. M. F. at a given speed, and switching mechanism for throwing them into parallel circuit at will, together with means for balancing their counter-E. M. F. when thus connected.
Trolley Wheel, E. M. Tousley, Jamestown, N. Y., 501,548. Filed July 16, 1892.
Electric Railway Conduit, I. J. Cook, Newark, N. J., 501,676. Filed Apr. 28, 1892.
Electric Controlling and Locking Mechanism for Railway Switches and Signals, C. M. Wilder, Cincinnati, O., 501,701. Filed Oct. 17, 1892.

Telephones and Apparatus:—

Ear-Phone Attachment, C. W. Farr, Chicago, Ill., 501,690. Filed Apr. 14, 1893.
Transmitter for Telephones, J. A. Brown, Moline, Ill., 501,610. Filed Apr. 26, 1893.
Employs vibrating armatures before the poles of electromagnets, the armatures being actuated by the movement of the diaphragm.
Multiple Switchboard for Telephone Exchanges, C. E. Scribner, Chicago, Ill., 501,847. Filed July 30, 1892.
Designed to prevent the actuation of an individual annunciator by call signals sent subsequently to the establishment of connection.
Method of Preparing Cables for Multiple Switchboards, O. A. Bell, Brooklyn, N. Y., 501,859. Filed Nov. 7, 1892.
To economize material and labor in wiring switchboards.

CUTTER'S ECONOMIC DOOR SWITCH.

The number of incandescent lamps in any place depends not so much on the cost of the current as on the devices for readily turning the lights off and on so as to keep the consumption at a minimum. And even where the switches are conveniently located it requires some attention to turn them and if this is left to the hired help the chances are that the lamps may be left burning continuously. This is particularly the case with closets, storerooms and such places where the light is needed but rarely; such parts of the house have generally been left without any convenient means of lighting, merely for the lack of a simple device for controlling the current.

This want is now met by the "Economic Door Switch" devised by George Cutter of Chicago, which can set flush in the rabbet of the door jamb so that the door itself presses against the projecting button. On opening the door the light is turned on and burns until the door is closed when the switch shuts off the current. The action is automatic so there is no possibility of wasting any current when the door is closed, and no hunting for the switch in the dark. The added convenience is worth considerable, while the saving in current and in the life of the lamps will soon pay for the switch itself. Such a device will make the lighting of odd rooms and corners inexpensive and thus give electricity its well-deserved place throughout the house.

The switch as such is well built and has the conducting parts insulated from the casing by hard rubber bushings. The casing is cylindrical, so that it will slip right into a hole drilled in the woodwork, making the fitting a very simple matter. It is being put on the market by George Cutter and will no doubt meet quite a demand.

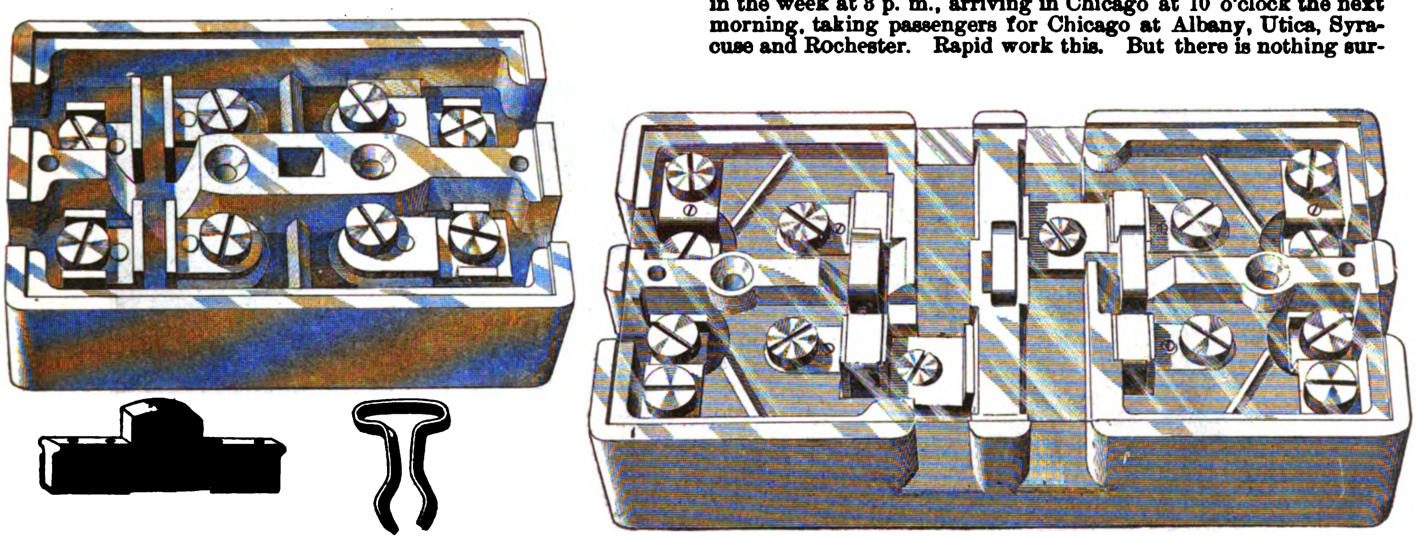
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE IMPERIAL CUT-OUTS.

THE IMPERIAL MANUFACTURING COMPANY, of No. 323 Washington street, New York, have just brought out a number of excellently designed cut-outs and branch blocks, in which the aim has been to fulfill the strictest requirements of protection against fire. The accompanying engraving, Fig. 1, illustrates a main cut-out, and Fig. 2, a double branch block which show the construction very clearly.

The insulation is all of porcelain or mica; no metal parts in circuit are exposed and every branch taken from the cut-out has its own fuses; all connection are on the face of the block. It will be seen that all parts of different polarity are carefully insulated from each other, and each fuse is confined in a separate compartment so that all possible danger of trouble in the cut-out is avoided.



FIGS. 1 AND 2.—THE "IMPERIAL" MAIN CUT-OUT AND DOUBLE BRANCH BLOCK.

It will be noticed that between the fuse terminals the porcelain base is depressed with a ridge in the centre to support the fuse in case it should sag. Fuses which touch the base of the cut-out for a considerable portion of their length, it is claimed, conduct the heat away by the colder porcelain largely increasing the carrying capacity above the normal. The construction here adopted enables the fuse to operate at its proper fusing point.

A double pole plug switch in each branch of the cut-out enables the current to be broken, and the fuses can be inserted without trouble therefrom. It likewise affords a convenient means of disconnecting any circuit for testing, or when not in use, it can be used to cut off lights instead of a switch. It will be noticed that the cover is conveniently attached, permitting ready removal without the use of a screw driver. These cut-outs are furnished without the plug switch when desired.

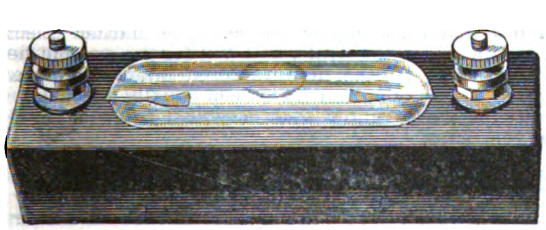


FIG. 3.—THE "IMPERIAL" POLE INDICATOR.

Besides the forms illustrated, the company also manufacture single branch blocks and single-pole fixture cut-outs embodying the same principles as those just described. In order to bring their cut-out blocks to the highest state of efficiency the company has prepared a line of fuse links, of a special alloy. The metal, while having a low melting point is sufficiently hard to be used without copper terminals, and is not sluggish under excessive current. In case extra hard terminals are required the fuses are furnished with copper plated ends.

Among the other specialties of the company is the pole-indicator, illustrated in Fig. 3. When placed in circuit, the negative pole of this instrument as well as the adjacent liquid is quickly colored a bright red, which disappears when the indicator is shaken. The instrument may also be used as a level, and is accurately adjusted for this purpose. It is made in two types, namely, of high resistance, for any circuit up to 600 volts, and of low resistance. The latter type is extremely sensitive and may be used instead of a magneto in testing, as it will indicate through a circuit of 25,000 ohms resistance with sufficient cells in circuit to give five volts. It is intended for circuits carrying potentials up to 25 volts.

CHICAGO FIVE HOURS NEARER.

THANKS to the enterprise of the New York Central management, there is now a regular twenty-hour service between New York and Chicago. This wonderful train bears the appropriate name of the Exposition "Flyer" and leaves New York every day in the week at 3 p. m., arriving in Chicago at 10 o'clock the next morning, taking passengers for Chicago at Albany, Utica, Syracuse and Rochester. Rapid work this. But there is nothing surprising about it. The Central is in the field for traffic and gets it just because the public are convinced of the road's superior equipment. When one travels by "America's Greatest Railroad" he expects a service above the ordinary, and he is never disappointed.

ANSONIA ELECTRIC CO.]

THE ANSONIA ELECTRIC CO. report that their sales are on the steady increase, notwithstanding the closeness of the money market, and their outlook for fall trade was never better. They have from three stations the promise of orders in the very near future aggregating about $25,000. The sale of Wirt dynamo brushes by the Ansonia Electric Co. is still on the increase. The Ansonia Electric Co. are offering their fan motors at very low figures, as the fan season is well advanced.

PERRET MOTORS.

To while away dull times for themselves and their customers the Elektron Manufacturing Company are making a special offer of some of their standard stock at tempting rates. These Perret motors in the smaller sizes are excellent machines, and range from $\frac{1}{12}$ h. p. up to 2 h. p. The $\frac{1}{12}$ are for battery current, but there are also $\frac{1}{8}$ h. p. motors for 110 volts, some with lever switch and some with lamp resistance. The $\frac{1}{4}$ h. p. are 110 volt shunt motors and the 2 h. p. 230 or 500 volt shunt motors. Such machines at $100 are well worth acquiring for a great variety of work. Our readers should address the Elektron Company at Springfield, Mass., for full details.

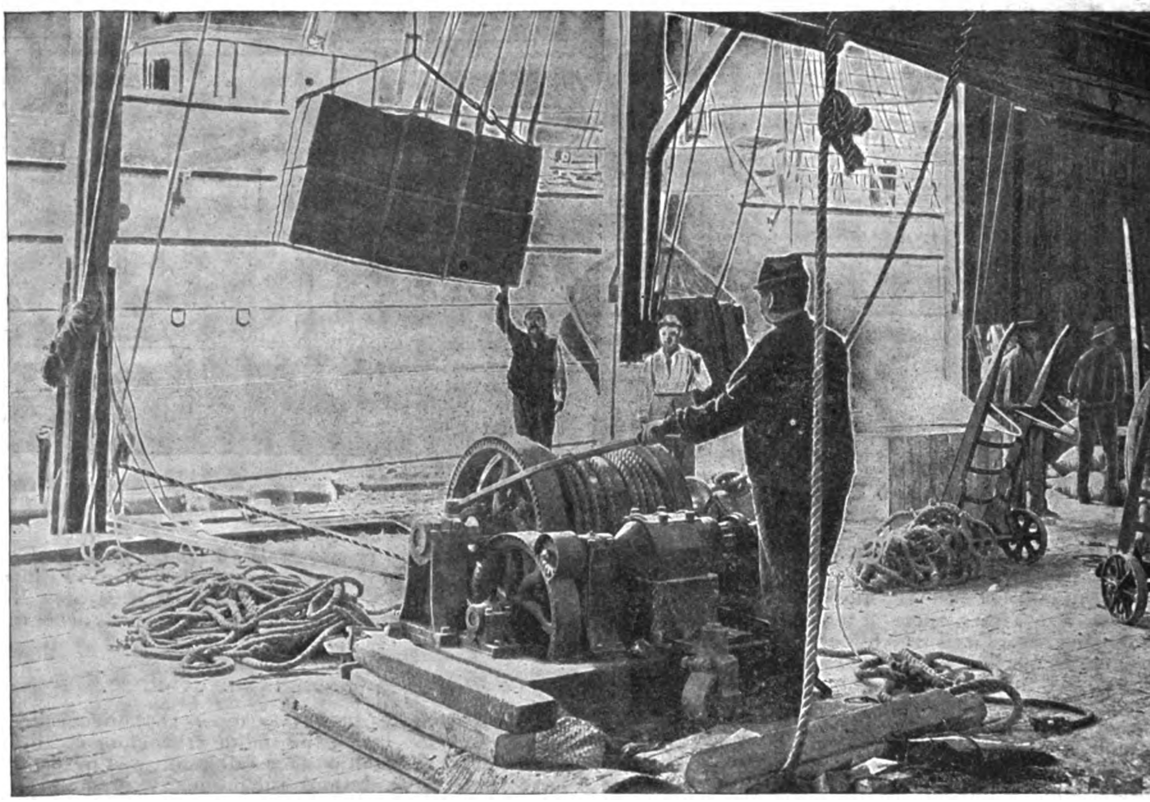
KERITE.

MR. W. R. BRIXEY reports the sale of $10,000 worth of Kerite aerial cable in New York city, and six submarine cables for Camden, N. J.; three of seven conductors for the Western Union and three of 18 conductors for the Metropolitan Company.

RECORD OF GENERAL ELECTRIC DOCK HOISTS.

An interesting example of an advantageous substitution of electrical power for that of steam is afforded in the installation of electrical box motor hoists which have been in operation during the past two years and a half on the wharfs of Sanderson & Sons, in Brooklyn, where the Wilson Line transatlantic steamers discharge. The installation, made by Messrs. Curtis & Dean, comprises nine 10 h. p. General Electric hoists of the drum and winch head type in continual use, loading and unloading the vessels which are constantly arriving and departing. The driving motors are of the well-known bi-polar type.

When the hoists were first installed, opinions were freely expressed that they could not possibly do the work as cleanly nor as rapidly as the donkey engine, and that they would soon get out of order, prove costly of repair and give way to the triumphant returning steam hoist. The workmen especially viewed the innovation with disapproval. The hoists have now been in operation for two and a half years and the trend of opinion is now diametrically opposite. The owners would not be without them, and the men are so convinced of their many superior features that any proposal to return to steam hoists would arouse an active protest. They are readily moved from place to place on the wharfs or upon the vessels themselves wherever they may be needed, require little or no attention and are made ready for service by the mere connection of the conductors to the service wires.



General Electric Dock Hoist, at Brooklyn, N. Y.

Perhaps the most important feature emphasizing the superiority of these electric hoists over their predecessor, the steam hoisting engine, is that of repairs. During the two and a half years in which these hoists have been under continual daily duty, the total cost of repairs has amounted to the phenomenally small sum of $24.75, or $2.75 average for each hoist. It may be doubted whether any such fact as this has ever been recorded about a steam hoist. This installation is by no means exceptional. Electric hoists are superseding the steam hoist, not only in marine and wharf work, but in factories, mines, engine shops and other places where economy, rapidity of work and perfect operation are requisites.

WOOLF ELECTRICAL DISINFECTING PLANTS FOR NEW YORK CITY.

The description of the Woolf electrical disinfecting plant at Brewsters, N. Y., which appeared in our issue of July 19, has attracted widespread attention and the inventor, Mr. A. E. Woolf, is in receipt of many communications from all quarters with respect to his system. The results already obtained have been such that the Department of Public Works of New York, has ordered a plant to be erected at the Sodom reservoir sufficient to treat 60,000,000 gallons of water per day, which was put in operation last week. Another plant of equal capacity will shortly be erected at the Kensico reservoir. In addition to these the New York Board of Health has given an order to erect a Woolf plant at the Willard Parker Hospital at the foot of East Sixteenth street. This plant will have a capacity of a 1,000 gallons per day and will furnish the disinfectant for all the hospitals and disinfecting stations under the control of the Board of Health. The health officer of the port of New York, Dr. Jenkins, has also ordered a 1,000 gallon plant to be installed on board the "Governor Flower," the health officer's boat.

GOING SLOW IN THE ELECTRICAL FACTORIES.

Owing to the great dulness and depression in industry, due to the financial stringency but certainly not to overproduction in any department, some of the electrical factories have curtailed their usual operations. The General Electric Co. has put its shops at Schenectady an a basis of five working days per week. The Westinghouse Electric Co. has limited its force of men to those necessary to get out work in hand, but is not attempting to accumulate any stock of finished machines. The Eddy Manufacturing Co. of Windsor, Conn., will run five days a week of eight hours each until further notice. The Mather Electric Co. has closed down for a while, and will for the present devote its energies to selling off the manufactured product now awaiting customers. Other concerns have been equally cautious, but it is some satisfaction to know that electrical trade is rarely overstocked very long.

The Electric Appliance Company have recently added to their World's Fair exhibit a lot of 20 finely finished fancy reels of Paranite Wire. The reels are stacked in the four corners of the space in such a way as to form four pyramids of reels tapering from very large at the bottom to small at the top. These reels thus serve the double purpose of helping to mark out the space and making an attractive exhibit of Paranite. This addition just about fills up the Electric Appliance Company's space.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

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SUGGESTIONS TOWARD IMPROVING THE EARNINGS OF UNPROFITABLE CENTRAL STATIONS.

BY

J. H. Vail

HOW shall electric light stations not now showing good net profits be brought into the ranks of dividend earners? This is a question that undoubtedly interests many investors who have placed money in electric light stations that do not pay. As mentioned in a previous article on "High Economy in Central Stations,"[1] there are many stations where injudicious combinations of apparatus and excessively bad engineering and construction have placed such electric companies in an almost hopeless condition; but setting these aside for the moment, the writer believes there are means of bringing about the desired result in numerous instances under favorable conditions.

The term Central Station is now generally accepted as designating the building and plant requisite for generating electricity for public supply. It should apparently be taken in a broader sense, such as a plant for the purpose of obtaining from coal the energy therein stored in the form of heat, the said energy being distributed from the station in such manner that it becomes most useful and profitable as a public commodity. Steam must at present be recognized as the intermediate agent for attaining the result. One of the highly important requisites is an economical steam generating plant. Having such a plant of boilers and auxiliary appliances, it will be readily perceived that the heat units derived from the coal may be commercially disposed of in several forms; numerous sources of revenue can be added thereto with a reasonable increase of the investment and yet the same can be maintained under the general operating expenses of one board of management.

One of the most important factors necessary to the highest economy in operation of a central station is to have the operating staff possessed of such practical engineering ability as to know how to effect the greatest economy in fuel and maintenance of plant. A man of real engineering ability, even though he may require a high salary, will be cheaper than the one who does not know or care how to economize.

The investment having been made, every effort should be put forth to derive from the plant a revenue for every hour. Idle moments are a loss and should be turned to profit. The maximum revenue to be derived from a given steam generating plant has been attained in but few instances. Such maximum could only be obtained by selling the full output 24 hours per day, 365 days in the year. The aim of every central station management should be to secure this result in the highest degree. Large cities offer the best opportunities for deriving the maximum revenue from the distribution and sale of electric current. In the smaller cities and towns, it appears reasonable that additional sources of revenue should be combined to make the plant a better paying investment.

There are but few instances where the distribution and sale of the electric current has been developed to the fullest extent. The central station management should not assume that this point has been reached until the system covers all the territory within which customers can be supplied at even a small profit, when investment in line and proportion of operating expenses are duly taken under consideration. A careful survey of the field of electric lighting at the present stage of development, shows that the light is furnished almost entirely to stores, hotels and places of business. How few citizens know the convenience and beauty of the electric light in the home. Residence lighting has received but little attention. It is doubtful if five per cent. of the possible residence illumination is yet secured. This class of business is obtainable and will pay a good profit when judiciously developed under careful management. It is not claimed that residence lighting is profitable as an exclusive field; but it becomes profitable when furnished in connection with other service. It furnishes a revenue without any very large increase of investment or operating expenses.

It is not possible to describe within the limited scope of this article the several methods for distribution of energy; but we will consider three modern conveniences now regarded as necessities that may be readily manufactured under one combined central station generating plant, covered under one common roof, produced by the same labor, and disposed of under the direction of one executive management.

It has been more than once aptly stated that "a supply creates a demand, and a luxury in time becomes a necessity." In these days of advanced living, there are demands on the part of the public for at least three essential conveniences: Light, heat and refrigeration. As the company is organized, real estate owned, and the electric lighting plant already exists, the requisite investment will be much less in proportion to add the heating system or ice plant. The same boilers will be useful for steaming purposes, and the same executive management should be competent to supervise the additional systems. Thus while the profits on any individual system may be small, on the combination the profits should be large.

A consolidated central station combining the features above outlined should thus become a superior investment, as it would incorporate within itself such necessities of modern civilization as would enable the company operating the same to obtain a revenue from the developed energy for almost every hour per day and every day per year. We are frequently reminded that the waste products from gas works are of greater value than the gas itself. The statement has repeatedly been made that an electric light station cannot hope to compete with gas because there are no waste products to be turned to profitable account. This statement is correct in a certain degree only. The electric station has the advantage of adjusting the manufacture of its product exactly in proportion to the demand made upon the station by its customers for electric service. The larger

1. The Electrical Engineer, Nov. 16, 1892, et seq.

demand for current being between the hours of 4 p. m. and 12 o'clock midnight, much effort has been expended toward obtaining profitable business during the remaining hours of operation. The supply of electricity should be always at the command of the consumer, thus requiring constantly 24 hours daily operation of the station.

Electric motive power has proven to be a most valuable source of revenue, and therein the electric light station has a great advantage over any gas works. It is true that a gas company may derive a small revenue from gas sold for operating gas engines, but this will compare only as a small fraction with that derived by the comprehensive electric light station from electric motive power. The superiority of the electric motor over the gas engine, as well as its many diversified uses, is fully conceded.

The electric light stations are few that are favorably situated for using condensing engines, and the majority of stations being in towns of from 3,000 population upwards, with only an ordinary output of current, it becomes important to add other sources of revenue to make such central stations largely profitable investments.

Such stations struggle along from year to year, some not even earning a reasonable percentage on the invested capital, whereas many of them can be made immensely profitable by consolidating certain other modern necessities under the same management. If the truth were concentrated in a table of statistics, the writer believes it would be shown that a great many electric light stations are not proving to be large money makers. Probably the majority of such stations are using high pressure engines, the exhaust from which may be considered as a waste product of no little importance, if it can be profitably utilized. The object, therefore, is to set forth, briefly, at least two sources from which additional revenue can be readily obtained.

The idea is not a new one that the immense volume of exhaust steam discharged from day to day into the open air, contains an enormous quantity of heat that is wasted in the course of the year's operation. It has often been stated that only ten per cent. of the energy contained in the coal consumed is utilized in the engine. The object is to show how some revenue can be derived from the heat now thrown away. In presenting the matters herein outlined, the writer makes no claim to originality in description of methods, but fully believes that the combinations proposed have not previously been introduced.

A heating system will give an additional revenue during the winter months. The advantage of using the waste or exhaust steam for heating purposes has been so often discussed that the points are generally acknowledged among engineers and steam users, and it is unnecessary to dwell upon merits and disappointments. We will therefore stand by the statement that if we can successfully utilize exhaust steam and change the waste steam into a source of profit by methods that are correct in principle, both theoretically and from a practical engineering standpoint, that then we have something deserving of attention.

Exhaust steam from electric light stations varies in quantity according to the load on the station, the size and number of engines and the hours they are in operation. Where the exhaust is discharged into the pipes of the steam heating system, its prompt discharge from the engine is more or less impeded and is seldom entirely unobstructed, and the back pressure thus produced on the exhaust side of the piston must be overcome to an equal degree by live steam on the opposite side of the piston.

The degree of back pressure or retarding effect is dependent upon the freedom of circulation in the steam heating system; hence many installations for heating by exhaust not only fail altogether to effect a profit, but actually help swell the amount expended for fuel. The writer recalls to mind a certain electric light station that was supposed to be deriving a good revenue from exhaust steam for heating purposes. The coal bills, however, seemed to be exorbitant, and an actual investigation of all the conditions showed that the steam heating system using the engine exhaust caused a back pressure of 10 pounds per square inch on the engines. The cause of the excessive expenditure for fuel is evident. As a result, for the fuel required to overcome the back pressure of the steam heating system, there was expended more money than the revenue derived from the customers served with heat. Further than this, back pressure causes additional loss by the reduction of the efficiency of the engine, as it impedes the expansive power of the steam. Another important defect of the exhaust steam heating system is that there are times when a sufficient number of engines are not running to furnish the requisite quantity of steam for heating purposes. And still another defect is that because of condensation, there is much loss in steam during transmission.

A comparatively new system of heating, known as the "Exhaust Hot Water Heating System," appears to the writer to afford to central station companies a practical method of utilizing the exhaust, and to overcome all of the difficulties that are encountered by the ordinary methods of exhaust steam heating. This system utilizes the exhaust steam from any and all sources, and this absolutely without creating any back pressure on the engines.

The surplus exhaust is unthrottled and can pass to the open air. The heat contained in the exhaust is stored in the water and continues to deliver its beneficial effect even after the engines are shut down. The heat is distributed uniformly and the circulation is positive. There is no loss of hot water. There can be no question but that this method changes the exhaust steam of large plants from a loss, into a source of income and profit, since it provides a method by which the heat is stored up and delivered at long distances, thus turning the same into a salable article of commerce.

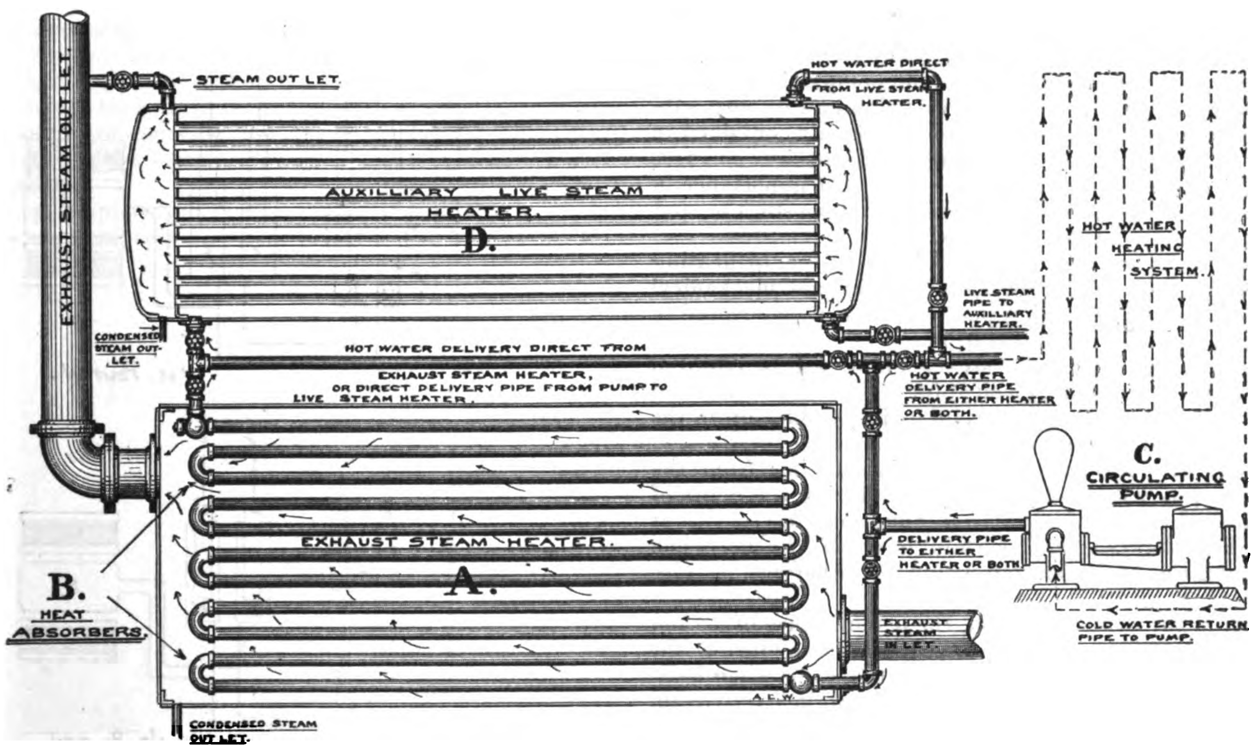
The system may be briefly described as follows: The exhaust steam is delivered to a large exhaust steam hot water heater (see page 147) which consists of a boiler plate box A of sufficient size to contain a series of brass coils or heat absorbers B. The pipes from the hot water, circulating and heating system are connected with these coils. The latter are of sufficient surface for the contained water to absorb all the heat from all the exhaust steam and deliver it to the water which is circulated by a pump, C, through the entire system. Should the exhaust steam at any time be insufficient to heat the necessary quantity of water up to the desired temperature, an auxiliary or live steam heater D is applied in connection with the exhaust heater. The construction of this is similar to the exhaust steam heater, but the operation is reversed—the hot water being passed through the shell and the live steam being contained in the coils.

The circulation of the water is maintained by a small pump running at a slow rate of speed. It will thus be seen that as the water is a medium of storage of the heat absorbed from the exhaust steam, that by the enforced circulation the heat is distributed where required. The heat that has not been radiated in its passage through the circulating system remains in the water and is brought back and added to for future needs. If there be certain periods during the day when there is not sufficient exhaust steam to accomodate the customers served, then live steam is turned on the coils in the auxiliary heater D, thus giving the desired temperature to the water passing through the heating coils and radiators. This system is a flexible one. The amount of exhaust available will to a degree determine the number of buildings possible to heat from one and the same plant. It will be readily understood that the piping system must be in proper condition with provisions for extensions, to such a degree as will not interfere with its efficiency.

It has been found in practical operation of this system that a remarkably small amount of power is expended in the pump to maintain the hot water in forced circulation. In constructing a system of this kind, it is of course essen-

tial that the many minor details necessary to bring this type of plant into satisfactory operation, shall be performed by experts who thoroughly understand the requirements. Existing systems for steam heating can be utilized in whole or in part, according as they may give a free or restricted circulation. In one building alone, in New York City, there have been applied for this system of heating, 216 radiators, having a radiating surface of 16,657 square feet, furnishing all the heat necessary for 813,000 cubic feet of space with an allowance of about one square foot of radiating surface to 50 cubic feet of space. The piping for the hot water system in the building referred to is nearly fifteen miles in length, ranging in diameter up to 12 inches. This system of heating has been practically demonstrated and is not an experiment. It can be applied with great economy and satisfaction in connection with isolated electric light plants.

The manufacture of ice and cold storage will afford an additional revenue during the summer months. Mechanical refrigeration is a new industry just on the verge of profitable commercial development and with great promise of future growth. The manufacture of pure ice and mechanical refrigeration are branches of mechanical science, which, in a commercial way, can readily be connected with the electric central station.



Exhaust Hot Water Heating System in Connection with Electric Light Plants.

In giving consideration to this matter, the central station company should steadily aim at the following essential features: 1. Adaptability to satisfying the heaviest demand; 2. Economical use of cooling agents; 3. Capability of making ice as required; 4. High refrigerating power; 5. Ease and cheapness in operating. All of these points must be persistently kept in view, as they are the embodiments of the most advanced knowledge on the subject, gained by the mastery of difficulties that have presented themselves in actual work.

It is not necessary at this time to enter upon any description of the principles embodied in mechanical refrigeration and ice making other than to say that three different systems may be considered, viz.: *First*, the *compression* system, which has three stages of operation. 1st, compression of the gas; 2d, condensation of the gas and the withdrawal of the heat caused by compression; 3d, expansion of the gas and absorption by it of heat from the surrounding objects. *Second*, the *absorption* system, which differs only in slight particulars from the compression system. In the absorption system, the gas, instead of being compressed by mechanical means, is obtained from an aqueous solution of ammonia which is heated in a boiler or still until the gas is driven off. *Third*, the *vacuum* system is still another method of refrigeration but is principally used for ice making only. This system is undoubtedly the one which nearest approaches to the process of nature but it is not found possible to produce and maintain a perfect vacuum without the aid of auxiliary substances and the difficulties thus far encountered have been found insurmountable and expensive.

The utilization of refrigerating processes for commercial purposes have developed so broadly within the last few years as to suggest almost endless possibilities. The use of mechanical refrigeration in storing vegetables, fruits, eggs, meats and other perishable products while a commercial success in large cities, has not become a regular commercial method in smaller cities and towns, but to the investor offers a most inviting field, particularly when the plant required for refrigeration can be connected with an existing central station and the steam plant therein may be utilized during hours when all boilers are not required for electric generating purposes. The possibility of the cooling of offices, sleeping apartments, living rooms, dining rooms, etc., by mechanical refrigeration have been considered to some extent and there is no question that the temperature can easily be reduced in such places down to 70 or 75° Fahr. The room cooling process, scientifically applied, would remove the possibility of many discomforts in the summer and many persons who now suffer from nervous prostration as the result of overwork during the depressing time of hot weather, would be entirely relieved and probably maintained in perfect good health. Another proposed plan for the application of mechanical refrigeration is the cooling of water in street mains so that it is fit to drink in warm weather, without the addition of ice. This plan has not been tried commercially on a large scale, yet there is no question that it can be made successful to some extent.

The manufacture of ice is proven to be commercially successful. The writer has investigated ice manufacturing plants

operating as independent concerns and finds that with coal costing $3.50 per ton, the gross cost of ice from pure, distilled water is not over $1.00 per ton. As this includes labor and all expenses of manufacturing, it will readily be seen that there is a large margin for profit. The ice is much superior in many respects to natural ice. It is perfectly pure and is ready for delivery at a far less cost than natural ice. That much natural ice is reasonably pure no one will doubt, but few of us know where the ice comes from that we use each summer for domestic purposes. Unfortunately many dealers in natural ice give no care whatever to the purity of the product. The ice is frequently cut from standing bodies of water in near proximity to large cities or from rivers or lakes which receive sewage, or from marshy pools or other locations where pollution exists.

The popular notion that the impurities in water are excluded from ice, has proven to be delusive and erroneous, as eminent authorities have shown that the bacilli of typhoid fever will live in ice for many weeks or months. On the other hand, it is safe to assert most emphatically that no natural ice can be found so pure as artificial ice, made from distilled water. Distillation not only exterminates all disease germs, the same being subjected to a temperature of 212°, but it leaves behind all impure substances and gases. It also drives off the air contained in the water, rendering the ice made therefrom, clear and free from air bubbles, which is a matter of great importance in considering the appearance of ice for domestic use, and also improves its lasting qualities.

It will be observed that by adding a system of heating for public service and of ice manufacturing and mechanical refrigeration, the following points will then be covered in the successful consolidated station:

First, the service of the steam plant will be required nearly to its maximum capacity for 24 hours per day and for 365 days per year, thus bringing its product up to the point of highest earning capacity.

Second, the service of commercial heating from the central station will mostly be required during the hours of daylight and in the *winter season*, thus covering service at a period of the year and certain hours of the day when the capabilities of the station would not otherwise be fully taxed.

Third, in the *summer season*, the manufacture of ice and mechanical refrigeration could be carried on during the hours of daylight and at a season of the year when heating is not required, thus assisting in bringing the steam plant up to its maximum earning capacity.

The writer does not claim that combinations of electric lighting, heating and refrigeration are necessary in connection with central stations in large cities where the demand for current covers nearly the entire 24 hours per day, but there are many towns ranging in size from a population of 3,000 up to probably 30,000 wherein such combinations could be made eminently profitable, if investments are judiciously made under competent engineering advice.

The question naturally presents itself as to the amount of new investment required for the addition either of heating or refrigeration as above outlined. It is impossible to name any definite figures because the local conditions surrounding any specific station or the distance to which the heating system might require to be carried will be a factor in governing the cost of the equipment. It might, however, be stated that approximately $10,000 will be the minimum amount required for the application of either system, but careful investigation and surveys are necessary to arrive at accurate figures.

ELECTRIC TRACTION AT PARIS.

It is proposed to establish more electrical tramways at Paris, worked by accumulators. The first will be composed of three cars, and will run from the Place Saint-Augustin to Vincennes; the second will start from Neuilly and proceed to Saint-Ouen. A special charging station, with Farcot steam engines and Desroziers dynamos will be established at the tramway depot.

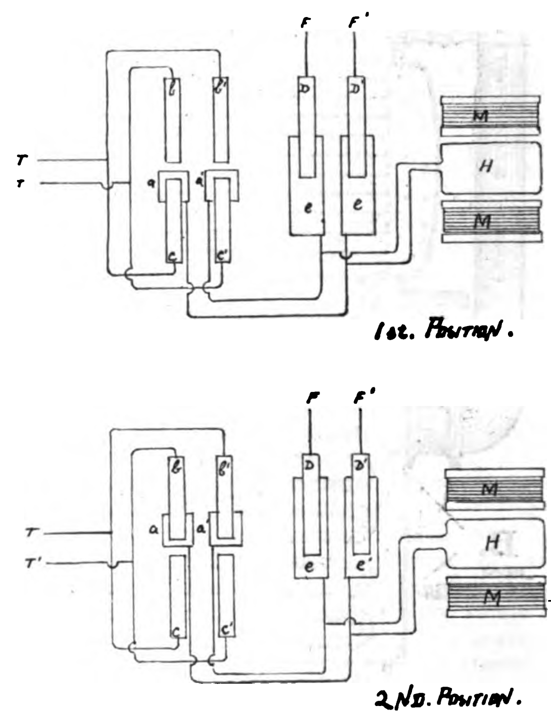
AN IDEA FOR A CURRENT RECTIFIER.

BY

Edw. M. Gerry.

In connection with the article in your issue of July 19 entitled, "The Evolution of One Current Rectifier," allow me to suggest an "Oscillating Rectifier," which the accompanying diagram will explain.

The apparatus is in part a cylinder of wood or rubber, pivotted so as to oscillate freely; the distance between the two points of rest being about one-sixth of a complete turn. On this cylinder are plates, *a*, *a'*, in contact alternately with the two pairs of brushes *b b'* and *c c'*; and plates *e e'*, always in contact with brushes D D'. In connection with this cylinder, and turning with it, is the coil H, acted upon by magnets M M which are in circuit with



A Current Rectifier.

the alternating current, their polarities changing in accordance with the current. The coil H is in connection with the direct current. Projecting pins on the cylinder strike against cushion springs which serve to relieve the strain and tend to overcome the inertia of the cylinder in its return movement.

Referring to the diagram of the first position, the alternating current enters at T T' and passes through to terminals F F', part going through the coil H, which is caused by magnets M M to turn, bringing the plates *a a'* in contact with the other pair of brushes, as seen in the diagram of the second position. Then, the current, having changed its direction, produces a flow of current at the terminals F F' and in the coil H in the same direction as at first, but changes the polarity of the magnets M M. The coil is forced back and with it the cylinder to the original position, when the process is repeated.

The oscillations will agree with the alternations of the original current, and the rectified current will be a continuous flow from the terminals F F'. By a change in the connections, a direct current will become an alternating current on passing through this apparatus.

FIRING GUNS AT NIGHT BY THE AID OF THE SEARCH LIGHT.

BY

Max Loewenthal

Ever since the introduction of the search light into our navy, the endeavor has been made to discover various uses to which it may be put in modern warfare. Night attacks being of very frequent occurrence, perfect safety may be secured by that artificial sun, called the naval projector. Various uses of the search light have already been pointed out in a number of excellent articles[1] published in The Electrical Engineer, by E. R. Knowles, C. E., who also shows with how much accuracy and ease the projector may be controlled by hand, or automatically from a distance.

This advantage has suggested the following application to the writer. It consists in combining two of the most recent and important electrical inventions, which are used in our navy, both of which have stood long and severe tests, and have opened a new era in conducting naval warfare, namely, the search light and the Fiske range or position finders.

The principle which Lieut. Bradley A. Fiske, U. S. N., has so ingeniously applied to these instruments,[2] has

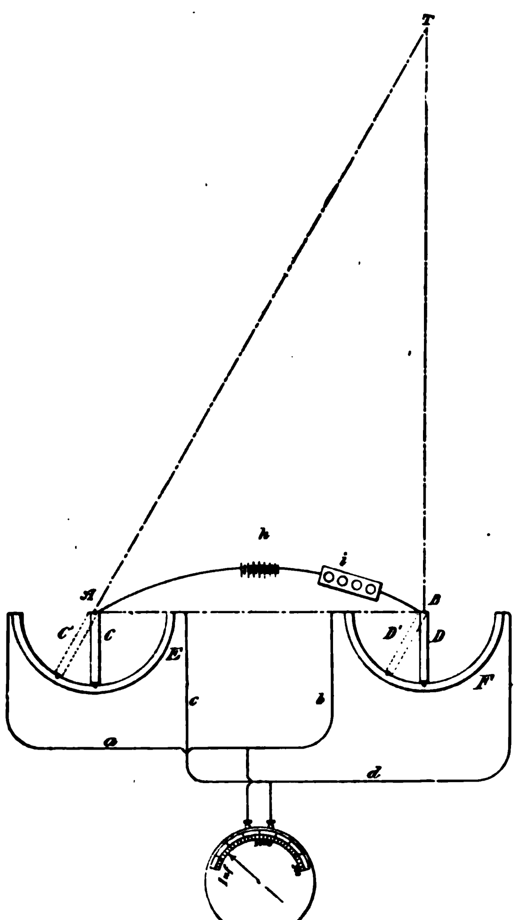


Fig. 1.

since then attracted the attention and compelled the admiration of all naval authorities, and it is my suggestion to use the very same principle in conjunction with the search light. I shall not enter into a description of the principle, but merely remark that it embodies a decidely novel application of the Wheatstone bridge as a means of measuring angles, and by means of which ranges or distances can be read directly from a scale, as shown in the accompanying diagram, Fig. 1, which explains itself.

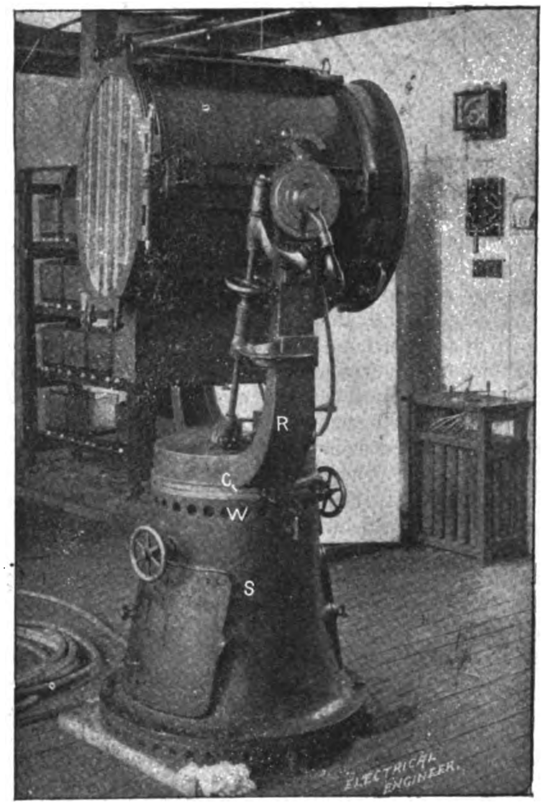


Fig. 2.

My principal suggestion is to use the search light in conjunction with a gun. Station a search light at A and a gun at B, the search light is turned until it points directly on the object. Then the gun is revolved at B until the arms of the bridge are again balanced, which is indicated on the galvanometer. Having thus obtained the direction and range, the gun can be fired with tolerable assurance that it will hit its mark.

For preventing an attack by a torpedo boat in the evening or when it is yet light enough to see by, a telescope may be stationed at A and a search light at B. When the torpedo has been spied by the telescope, the search light will serve to blind the operator of the torpedo boat and render him helpless.

In Fig. 2 is shown how the arrangement may be attached in a very simple manner to the present style of projectors, which consist of two main parts; the base, which is stationary, and the arms which carry the drum. These arms or supports may be revolved horizontally and in so doing, make, at their junction with the base, the electrical connection of the lamp terminals. Referring to the figure, the wire may be stretched around at W on the upper part of the base S, and a wiping contact fixed at C on the lower edge of the arms R. A small switch may be attached, so as to open the circuit when the arrangement is not in use.

1. The Electrical Engineer, July 27, Aug. 3 and 10, 1892.
2. The Electrical Engineer, Oct. 1 and Nov. 12, 1890.

THE TROLLEY PREFERABLE.

New York is having a lively time with the grip cars. The runaway car has created excitement on several occasions. There is no telling what damage one of these cars will do some day. The cities which have adopted the trolley system have not much occasion for self reproach after all. It is a pretty poor trolley line which is not better than a cable car system.—*Buffalo, N. Y. Enquirer.*

THE MOMENT OF REVERSAL IN THE QUADRUPLEX NEUTRAL RELAY — THE WICKS ARRANGEMENT.

BY

Wm. Maver, Jr.

THE quadruplex system which is now in extensive use in this country is a combination of the increase and decrease of current method employed in the Stearns duplex, with the reversal of direction of current method employed in the operation of the polar duplex. A "transmitter" is used to produce the increase and decrease of current strength on the circuit and a pole changer is employed to effect the desired reversals of polarity. A receiving instrument, commonly termed the neutral relay, is used to respond to the increase and decrease of current, and an instrument termed the polarized relay to the reversals of direction of current. The neutral and the polarized relays are differentially wound, and the arrangements of the system are such that they respond only to signals from the transmitter or pole changer, respectively, at the distant station.

The neutral relay, as stated above, is assumed to respond only to the increase and decrease of current, but as it is in the same circuit as the polarized relay, it is, of course, subjected to the reversals of the distant battery and at certain times, namely, when the full distant battery at the distant station is to the line, the reversals have a tendency to confuse the signals received on the neutral relay. On the other hand, the only effect of an increase or decrease of current upon the polarized relay is to cause its armature to be more or less strongly held to whichever side it may be at any moment attracted.

Many and various have been the devices suggested and employed for the purpose of reducing or tiding over the moment of reversal of magnetism in the neutral relay. Edison was probably the first to devise a remedy for this defect, which defect he termed the "bug" in the quadruplex; a term, by the way, which is now in shop parlance, very generally used in reference to any defect in electrical apparatus. Edison's remedy consisted in placing the local contact point of the neutral relay on the back stop and then using a repeating sounder to convert the signals to the "front" stroke. This device, which was used for many years, gave, on the whole, very satisfactory results, but, nevertheless, the neutral "side" of the quadruplex system has always been the weaker side, and during stormy weather, and, especially on long circuits, more or less poorly insulated, it has very often been necessary to abandon that side. The occasion of this necessity was doubtless largely due to the inherent inferiority of the old style neutral relay, which was simply a modified Morse relay, as compared with the polarized relay used on the polar side of the system. But much of the inferiority of the neutral side was also due to the breaking up of the signals on the neutral relay by the reversals on the polarized side.

Mr. Gerritt Smith and Mr. F. W. Jones, respectively, devised apparatus for diminishing or tiding over the moment of reversal in the neutral relay, both of which devices have frequently been described.[1] The Jones device has been in operation on the circuits of the Postal Telegraph Company for several years. The Smith device up to within a recent date was generally employed on the lines of the Western Union Telegraph Company, but it has recently been superseded on many circuits by a relay devised by Mr. S. P. Freir, which was well described in these columns by Mr. Wm. Finn.[2] In this relay Mr. Freir successfully seeks to minimize the moment of reversal by using a so-called self-polarizing relay, whose armature is polarized by a magnet which is itself differentially wound, and the coils of which are placed in the main circuit in the usual way. As by this arrangement the poles of the armature and the poles of the relay proper are reversed at the same time it is clear that the armature will always be attracted by a particular end of the relay. The armature of the relay is provided with a retractile spring which is so adjusted that it withdraws the armature from its contact point excepting when the entire distant battery is placed to the line, as in the case of the ordinary neutral relay. The reversal in this instrument is of very short duration and it has been found in actual practice to possess decided advantages over its predecessors.

The writer also several years ago devised a neutral relay, upon the principle of the Siemens dynamometer, which it was thought would permit of speedy reversals, and a short description of which may here be of interest, inasmuch as it has not been hitherto published so far as I am aware, outside of the Patent Office Gazette.

This relay is shown in Fig. 1. It consists of two differential coils in series, one fixed, the other movable. When

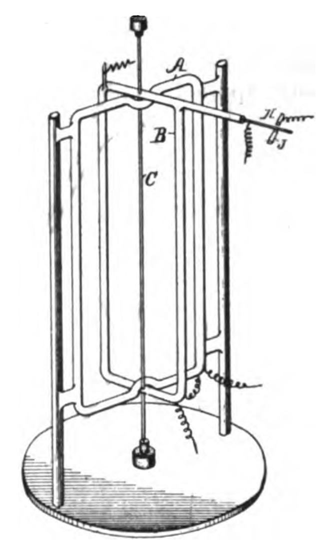


FIG. 1.

the coils are so connected that the current in adjoining legs of each coil flows in the same direction the movable coil is attracted, and, of course, as the reversals of current in the coils due to distant reversals occur in each coil simultaneously, the arm H attached to the movable coil is always attracted in the one direction, as in the case of the armature of the Freir relay. This device has not yet had the test of practice.

Quite recently a novel and, as I think, very pretty arrangement for use on the neutral side of the quadruplex has been brought out by Mr. P. J. Wicks, of New York City, which arrangement, it may be said, avoids entirely the moment of reversal in the neutral relay and introduces, instead, a brief instant of diminished current only in the relay.

It is well known that the self-induction of a relay will retain the armature for a brief interval after the original current has been withdrawn. On the other hand, it is next to impossible to make a moment of reversal of magnetism so brief, but that the armature will be withdrawn by its retractile spring. The former fact is taken advantage of in the Wicks device to insure a practically continuous current through the neutral relay at the time of reversal of the distant battery.

The Wicks arrangement is shown in Fig. 2. The main

1. For an excellent description of these methods see "American Telegraphy," by Wm. Maver, Jr.; pp. 204, 206. EDS. E. E.
2. See THE ELECTRICAL ENGINEER, March 29, 1893.

receiving instruments only at one terminal of a quadruplex circuit are shown. P R is the differentially wound polarized relay ordinarily employed. P R^{1} is an extra polarized relay, also differentially wound. A A are resistances forming the arms of a Wheatstone bridge. N R is a two-coil neutral relay. One terminal of each coil is connected to one arm of the bridge; the two remaining terminals are joined and connected to a contact point at the armature *a* of P R^{1}. A wire W connects the armature *a* to the other arm of the bridge. Hence, normally, one or the other coil of the neutral relay N R is in the bridge wire.

If the armature of the extra polarized relay were stationary, only one coil of N R would be in circuit and the reversals of current direction flowing through that coil, due to the reversals of the distant battery, would be felt as in the ordinary neutral relay. But as the armature *a* oscillates from side to side, in response to the distant reversals, it follows that the current in the bri lge wire flows in each coil alternately, and although the direction of the current as a whole in the bridge wire is, of course, reversed in accordance with the reversals of the distant battery, still, owing to the manner in which the coils of the neutral relay are arranged, the current passing around the core of that relay is always in the same direction and thus it ensues that no reversals of magnetism take place in its core, and the momentary break of the circuit at the

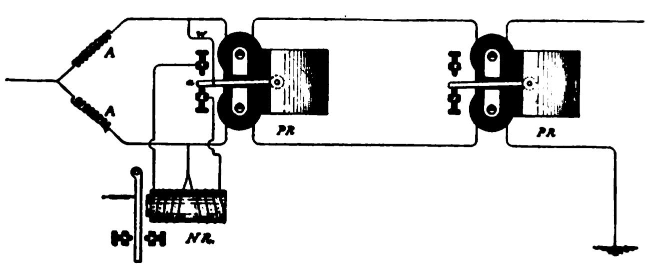


FIG. 2.

moment when the armature of P R^{1} is passing from one contact point to the other is not materially felt.

The experiments thus far made with this arrangement indicate that it will prove a successful working device.

Another device recently tried as a neutral relay consists in suitably placing over the poles of the polarized relay an iron diaphragm and providing it with a local contact point. The tension of the diaphragm is so regulated that it is only attracted by the full distant battery. This principle has frequently been tried before, Messrs. Gerritt Smith and S. D. Field having devised various relays on this general plan. It may be noted, however, that relays constructed on this plan are all subject to the effect of the distant reversals.

ELECTRICALLY-CONTROLLED CLOCKS ON LIGHTING MAINS.

THE Allgemeine Elektricitäts-Gesellschaft is now using an invention of Herr von Hefner-Alteneck, for utilizing central stations in connection with electrically controlled clocks. The invention consists in a clock so arranged that it can be coupled to the lighting mains, and is periodically wound up by electrical means. Once a day, the clock is put right by means of a small and momentary diminution of pressure on the mains, about six to ten volts, this being done at an hour when few lamps are on. It is necessary to keep the pressure right just before the clocks are set daily, but variations at other times do not affect the working. The setting can be done automatically by a standard clock, or by hand, and the cost of winding is said to cost about eight cents per year.

ELECTRIC INTERFERENCE IN A LIQUID LAYER.

To produce electric interference, M. R. Colson (*Comptes Rendus*) uses a Ruhmkorff coil fed by a thermopile. The ends of the two copper wires from the coil are in contact with a moderately conducting layer, formed by a liquid cooling on a glass plate. The two contacts form two poles, whence the electric flux is propagated in the liquid coating in periodic circular waves. A telephone is used with a contact movable in the liquid layer, the other contact being insulated and in connection with a constant capacity. In this manner the neutral point can be examined, as in wires, as the perception of the minimum sound is perfectly distinguishable. A series of points is thus obtained giving a neutral continuous line whose form varies according to the nature of the liquid, the distance separating the two poles, and the strength of the current passing.

THE DURATION OF INDUCTION COIL DISCHARGES.

SOME recent investigations of Dr. Lewis Jones on the duration of the discharge of an induction coil present several points of interest. He uses a very sensitive chemical recording device, far more delicate than that of Bain; and a tracing made by the current shows that there is no dragging out of the record, either by continuation of the chemical action or by accumulation of coloring matter under the stylus. No spark-gap was used, and the resistance of about 1,000 ohms, offered by the damp paper on which the record was made, approximates to that of the human body. The mean duration of the discharges was as follows: Make, 0.0046 second; break, 0.0134 second. The result shows that the discharge approximates much more to an ordinary alternating current than to an abruptly intermittent current.

WHITE LEAD BY ELECTROLYSIS.

IN the *Chemiker Zeitung*, xvi., p. 323, there is an account of an installation for the manufacture of white lead by electrolysis, in which is described the following new modification: Lead anodes, 3 mm. in thickness, are employed in electrolyzing the solution, the latter containing 300 cc. of nitric acid in 2,000 cc. of water; the lead salt formed when the current passes is precipitated as true white lead by means of a stream of carbonic acid gas, which is passed through the solution. In this process, any silver which the lead may contain is deposited on the cathodes, and can be recovered in a tolerable state of purity.

SAYERS' FEEDER COMPENSATOR.

MR. W. B. SAYERS has recently designed compensators for fall of pressure in feeders, designed to be used in connection with the 3-wire lighting system of the Midland Railway Station at Derby, England.

The compensator will be placed in the engine-room, the current to the feeder which it controls passing through it, by which means the pressure is automatically raised by an amount just sufficient to compensate for the drop in the feeder, whatever the current flow may be. In this way the necessity for hand regulation and pilot wires is dispensed with. The compensator proper consists of a pair of low-pressure series dynamos mounted on the same shaft, and driven direct by a constant-speed motor. The current to the extreme positive feeder traverses one of the armatures, and that to the extreme negative feeder traverses the other. In order to compensate for the drop of pressure in the third wire when a current is flowing in it, the balancing current is taken round the keepers in such a manner as to compensate for the disturbance which is caused by the drop when such a current flows owing to the unequal loading of the two sides of the system. Two sets of compensators have been constructed for the Derby Railway Station, one to carry a maximum current of 500 amperes, and to raise the pressure 1 volt for every 95 amperes; the other to carry a current of 400 amperes, and to raise the pressure 1 volt for every 55 amperes.

The method employed appears to be quite similar to that designed by Mr. W. S. Barstow, and in use for some time in the Edison stations in Brooklyn, N. Y.

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EDITORIAL ANNOUNCEMENTS.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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ELECTRICAL CONGRESSES.

THE International Electrical Congress to be held next week at Chicago is an event to which electricians and electrical engineers, theoretical or practical, have been looking forward with the greatest interest for many months. A vast amount of preliminary work has been done, quietly and assiduously, and now the time has arrived when the representatives of nearly every civilized country on the face of the earth will gather together to give scientific precision and official weight to the standards of electrical speech and measurement. The mere fact that a gathering of this kind attracts so many participants shows what great importance electricity has already assumed in the social economy of the nations. It is well that the Electrical Congress was not merged in the general Engineering Congress just ended, but stands alone, so that there will be full opportunity for careful discussion and an absence, or at least a minimum, of distractions and conflicting demands on the time of the members. The five days of the Congress can be put to good use, with the World's Fair as a good background for purposes of diversion.

Present indications leave little doubt that the coming Congress will contribute its quota to electrical knowledge and progress, both in the papers to be read and in the discussions which will be had on them. But it is perhaps in its official function that the Chicago Congress will aid electrical science and art most, by giving names to and defining units and quantities which have been suggested and some of which have already come into general use, though without official sanction. In this respect the Chicago Congress will occupy a position of authority which no previous congress, with the exception of that held in Paris in 1881, has possessed. The results of the Paris Conference, composed almost exclusively of Government delegates, were accepted without dispute by all, and the modifications which have since been made in some of their recommendations were the natural outcome of fuller knowledge subsequently gained. But to all intents and purposes the formulations of that conference are the only ones held in the respect which is necessary to general acquiescence. At the conference of Philadelphia in 1884, and the subsequent congresses in Paris in 1889, and at Frankfort in 1891, the small amount of actual work that was accomplished in the sections devoted to the consideration of electrical units and nomenclature may be traced first to the unofficial character of the gathering, and secondly, to the lack of preparation. In order to show how easy it is to pass a resolution at a general meeting of such a gathering, and yet how little weight it may carry, we need only refer to the resolution adopted at Paris in 1889, to designate the coefficient of induction as the "quadrant." This name was most strenuously advocated by the French members who, naturally, were in the majority at the time; yet no writer on electrical subjects to-day, even among the French, employs that term, all having adopted the "henry." Such a result seems hardly probable with any work of this nature accomplished by the coming congress. Foreseeing the inadvisability of leaving the determination of international matters to a general assembly, in which the electricians of America would of necessity be in the large majority, the organizers of the Chicago Congress wisely constituted a separate and limited House of Delegates—a Senate—composed of representatives appointed by their respective governments. It is this body alone which will consider questions pertaining to units and nomenclature The high character of the delegates who will thus sit in Chicago is a guarantee that their recommendations will be generally adopted. It is safe to say that in respect to preparation for the work it is to undertake, the Chicago Congress is better equipped than any previous gathering of this nature. For this important requisite to comprehensive action the entire electrical community owes a debt of gratitude to the able committee of the American Institute of Electrical Engineers who have had this work in charge, and who have striven to formulate as far as possible in advance the lines of procedure to which the Congress at Chicago can best give its attention and support.

CENTRAL STATION EARNINGS.

IT would be too much to expect that every central station erected should be a good dividend earner, the more so since many stations were erected at a time when but little experience had been gained in their planning and management. To bring such stations in some measure up to a fair earning capacity and on the other hand to further increase the value of more modern stations is a subject worthy of study by all engaged in electrical distribution. Some of the methods for accomplishing this much-to-be-desired end are ably discussed in this issue by Mr J. H. Vail, whose long and varied experience in this field makes his suggestions doubly valuable. It will be seen that Mr. Vail points to two new fields well worthy of attention, and well within the ability of most stations.

WORLD'S FAIR DEPARTMENT.

WESTINGHOUSE WORK AT THE FAIR.

Our readers will recall, in The Electrical Engineer of April 26, a description of the Westinghouse Machinery Hall service plant from which so large a part of the grounds

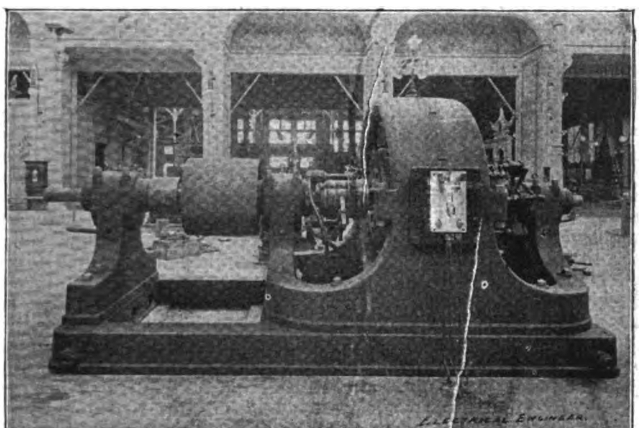


Fig. 1.—500 H. P. Westinghouse Rotating Transformer.

and buildings are lighted, and which is capable of supplying 189,600 16-c. p. lamps. At the time the article referred to was written, the plant was just being put in and was in a very backward condition. It will not, then, be amiss, now that it is complete, and nearly all the generators are in operation, to refer to it once more in connection with a brief review of the company's work at the Fair.

The power plant, occupying the space between columns E, 13 and E, 25 in the south nave of Machinery Hall, consists of six 750 kilowatt two-phase alternators, two of which are belted to a 3,000 h. p. Allis engine and the other four to 1,000 h. p. engines built by the Fraser & Chalmers, McIntosh & Seymour, Buckeye, and Atlas companies, respectively; six 750 kilowatt two-phase alternators, each directly connected with a 1,000 h. p. Westinghouse Columbian steeple engine; two 240 kilowatt single-phase alternators, each belted to a 350 h. p. Westinghouse compound engine, and three 75 kilowatt exciters directly driven by 100 h. p. Westinghouse compound engines.

The great white marble switchboard is designed for 12 two-phase and two single-phase alternators, four exciters and 40 circuits and controls nearly all the incandescent and a large number of arc lights in the grounds and buildings including the Midway Plaisance. The switches are so arranged that any one of the 40 circuits can be instantly connected with any of the 14 alternators, and regulating devices are provided for accurately adjusting the candle power of the lamps. All of the incandescent lamps are of the Sawyer-Man stopper type and the arcs are run from Westinghouse constant potential alternating current.

In the Electricity Building the exhibits of the company cover about 15,000 square feet of floor space and while standard Westinghouse alternating current lighting apparatus is fully represented, special attention has been given to recent developments and improvements in the field of applied electricity. In the space marked by the "Golden Pavilion" toward the northern end of the building is a complete power transmission plant using the Tesla polyphase system and touched upon in The Electrical Engineer of June 21, under the title of "Progress in the Electricity Building." It will be remembered that within this one space are shown a generating station, a high tension transmission circuit about 30 feet long and a receiving and distributing station. The first contains a 500 h. p. two-phase alternating current generator, a 5 h. p. direct current exciter, a marble switchboard and the necessary step-up transformers. In practice the generator and exciter would naturally be driven by water power and the former is, in fact, directly belted to a Pelton water wheel, but as water power is not available, instead of the wheel driving the generator the generator drives the wheel, or rather both generator and wheel are driven by a 500 h. p. Tesla polyphase motor with a rotating field, and the exciter by a 5 h. p. motor of the same type, both operated by current from the large two-phase alternators in Machinery Hall.

The switchboard at the generating station is connected with that at the receiving station by a four-wire overhead circuit. The high tension current is here transformed to 500 volts and distributed to various local circuits. A 500 h. p. two-phase Tesla motor and rotary transformer receives alternating current from the step-down transformers and, exercising its function of motor, drives a Worthington pump and a 40-light Westinghouse alternating current arc light dynamo. As a transformer it delivers direct current at 500 volts to two 30 h. p. railway motors mounted on a standard Dorner & Dutton truck, a 60 h. p. motor driving an Ingersoll & Sargent air compressor and several constant potential arc lamps. A 60 h. p. machine of the same type is shown supplied with two-phase alternating current from the reducing transformers. As a transformer it delivers current at 50 volts for electrolytic work, etc. Beside this is a 60 h. p. two-phase synchronous Tesla motor directly coupled to a 45 kilowatt Westinghouse slow speed constant potential alternator for incandescent lighting.

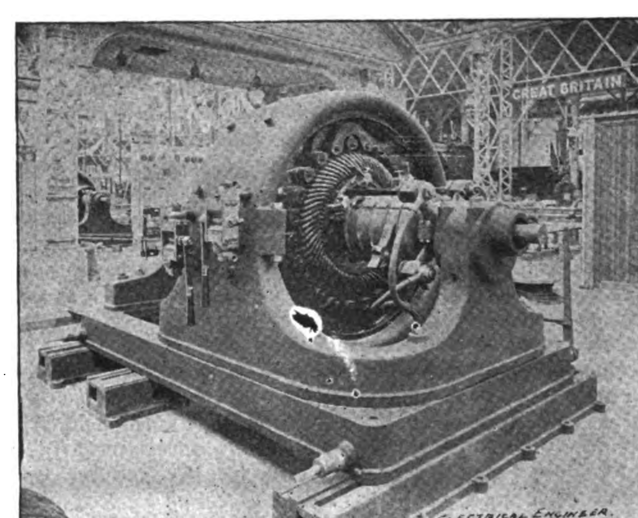


Fig. 2.—500 H. P. Two-Phase Tesla Motor.

While this system permits the use of exceedingly high tension for transmission over great distances, it delivers both alternating and direct current at any potential at the receiving end of a single circuit from one dynamo at the generating station. In no case is the value of its applica-

tion more apparent than in mining. Direct current from the rotary transformers is excellently adapted to haulage and hoisting, while the air compressors, lights, etc., may be operated by either the same current or that from the reducing transformers.

The street railway exhibit in the Electricity Building was fully described and illustrated in THE ELECTRICAL ENGINEER, of July 5. In addition to this, however, there are three supplementary Westinghouse exhibits. Thus, in

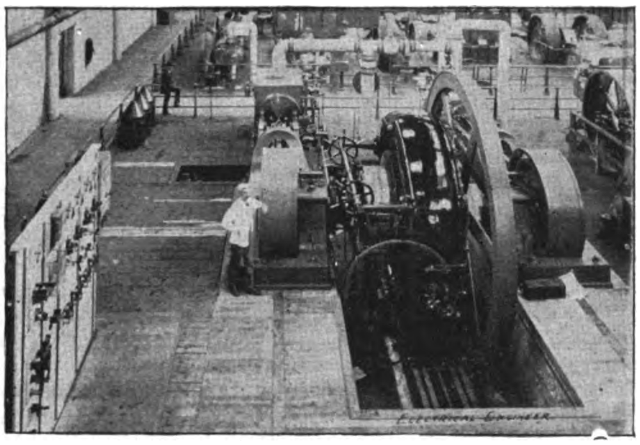


FIG. 3.—WESTINGHOUSE RAILWAY GENERATOR WITH ALLIS ENGINE.

the Transportation Building there is a Lamokin 18-foot car with two 30 h. p. Westinghouse single reduction motors and a series multiple controller, etc.; on an exhibition track near the north end of the Terminal Station is a 20-foot Laclede car similarly equipped, and in Machinery Hall has just been completed a 750 h. p. railway generator, the armature of which is mounted directly upon the shaft of an Allis engine running at only 90 revolutions a minute. This machine is unique. It has never before been assembled, as the armature, after being wound, was sent to Milwaukee, where it was fixed to the engine shaft. The illustration, Fig. 3, gives an excellent idea of the peculiar construction and the arrangement of engine and generator. A detailed account of the latter will be forthcoming as soon as it has been run and tested.

Apparatus for arc and incandescent lighting are shown in the Electricity Building just east of the railway exhibit, and include standard alternators of various sizes including the field casting of one of 450 kilowatts, showing the Westinghouse method of casting the laminated poles into the cast iron frame. Here are standard converters and transformers, special converters with non-arcing metal lightning arresters, direct current motors and generators of the horizontal, multipolar and Manchester types, alternating current arc light dynamos, Shallenberger meters complete and in operation, and also in parts to show the interior mechanism, Wurts non-arcing metal lightning arresters in operation, other types of arresters for direct currents, and a great variety of well-known styles of switches, ammeters and voltmeters for direct and alternating currents. In the southwest corner of the space is a dark room for special exhibits of high potential and high frequency phenomena, where exhibitions are given daily. Some of Mr. Tesla's early apparatus is also shown as well as some of that with which he has obtained such remarkable results in the use of high frequency alternating currents.

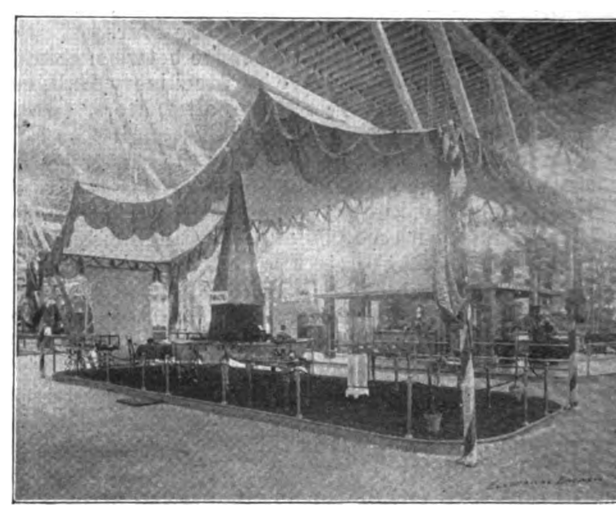
Nearly everyone is now familiar with the great Columbus mural decoration occupying the entire wall space above the south gallery of the Electricity Building and forming a conspicuous part of the Westinghouse display, where the lettering and decorative work is all outlined with Sawyer-Man stopper lamps supplied with current from the central station in Machinery Hall. The machinery in the Mines and Mining Building, or so much of it as is in operation, is run by two 150 h. p. 500 volt direct current Westinghouse motors, and a 20 h. p. motor of the same make operates an elevator in the New South Wales exhibit in the Transportation Building. The Yale & Towne crane in Machinery Hall, described in our last issue, is also equipped with Westinghouse motors of the Manchester type.

THE BRAZILIAN GOVERNMENT TELEGRAPH EXHIBIT.

THE Government of Brazil is doing great things at the Fair. The Brazilian State Building, a very attractive and imposing piece of architecture just across the lagoon from the Art Palace, has recently been thrown open to the public and is filled with the products of the country's industries and art, while twelve special exhibits in as many different departments show the skill and enterprise as well as the progressive policy of the youngest of the republics.

In the Electricity Building the display made is not large, but serves to show what has been, and is being done by the Government Telegraph Department and to this end consists mainly of instruments, apparatus and maps. Almost everything was made in Brazil at the Government shops and shows the skill of native artisans. Among the apparatus are several Morse instruments, differing but little from those in use here and elsewhere, but perhaps rather more solidly and heavily made. There are keys, resistance boxes, polarized relays, galvanometers, etc., of the same familiar types and requiring no description. The arrangement of holding the wire in the insulators, however, is quite different from anything in this part of the world. The insulators themselves are of the double petticoat type made by Siemens & Halske, and have at the top a hemispherical depression whose opposite edges are notched and above which are two holes at right angles to the notches. Two tin hemispheres, each having a groove in its plane surface, are fitted upon the wire as it is strung at each insulator and fastened together, making a little ball that fits snugly into the depression at the top. The tie wires are then run through the holes and secured in place. A number of wire joints are shown, none of which differs materially from the well-known styles employed elsewhere.

A Government fire alarm box is also on exhibition and is very similar to the old style Gamewell boxes formerly used here and



THE BRAZILIAN GOVERNMENT TELEGRAPH EXHIBIT.

improved upon as the growth of the system demanded. In one of the cases are two types of Fiske range finders the principle of which has been already fully described in THE ELECTRICAL ENGINEER, and considerable space is devoted to torpedo apparatus, fuses, exploders, etc. A large map at one end of the exhibit shows the telegraph and cable systems of the country, and beautifully executed detail maps are shown in portfolios. Some of the latter give the subfluvial cable systems in the interior where the Indians, wild beasts and insects are fatal to poles and overhead wires, and the fevers are equally so to the linemen.

Mr. I. M. de Limos Basto, Brazilian Commissioner and Director of Telegraphs, of Brazil, had general supervision over the arrangement of the exhibit, an engraving of which is shown on this page.

UNION ELECTRIC COMPANY'S EXHIBIT.

LOCATED in the northeastern semicircle of the Electrical Building is the exhibit of the Union Electric Company, of New York. They occupy the central position and on their one thousand square feet of platform exhibit their latest and most improved forms of storage batteries and also new developments in the form of motors, anti-friction metal and medical apparatus.

This tastefully arranged exhibit, over whose illuminated sign is appropriately draped the flag of the Union, forms one of the chief attractions of this part of the building.

Chief among the manufactures of this company is the Main high voltage storage cell. This was devised by Prof. William Main, their electrician, and is claimed to possess the advantages of high E. M. F. (2.4 volts), extremely light weight, entire absence of sulphating, and no buckling.

The positive plate of this cell is made of a number of thin sheets of lead enclosed between two stout outer sheets. These are all perforated simultaneously in a press and secured together by numerous lead rivets. The plates are "formed" by the prolonged action of a charging current which converts the thinner inside sheets completely into peroxide of lead, leaving the thick ones which are but superficially affected, as permanent retaining walls and supports. The transverse holes which remain open give free access of current and fluid to the interior of the plate, thus giving large active surface. No peroxide can drop out and the plate is uniformly discharged throughout.

The construction of the negative plate differs from the usual methods even more widely than that of the positive plate. It is made of an amalgam of zinc and mercury deposited electrolytically upon a copper plate; zinc gives a higher E. M. F. than the spongy lead usually employed and but little is required. The copper support gives permanence and high conductivity to what would be otherwise a perishable plate. Each copper sheet has a number of large perforations through it, giving a better hold to the soft amalgam, and hard rubber separators are used.

The method of connecting the cells is extremely simple and effective. The connecting wires are of copper, solidly coated with lead. The clamp is an oval collar of hard lead alloy, slightly tapered in one direction to correspond with a key wedge of the same material, which is lightly rapped into place, or pressed in with pliers. The inner face of the wedge is hollowed to fit the wire so that a considerable surface is driven into contact. Rapping the collar downward, or the application of pliers to the small end of the key and the upper face of the collar will loosen it in a moment and thus no brass or copper is exposed to the action of the acid. The plates of these cells, it is claimed, are not liable to disintegrate by rapid discharge or from standing idle. They absorb current rapidly and are not injured by overcharge.

The Union Electric Company also make and exhibit a cell in which both electrodes are made of lead from which an E. M. F. of two volts is obtained. Both plates are made in a manner similar to the positive plate before described. The cells manufactured by them range from 15 to 1,200 ampere hours.

They also show batteries in oak and mahogany boxes with carrying strap and binding posts specially adapted to physicians' use on account of their light weight; compactness and neat appearance. For physicians' use also there is shown an aluminum head lamp which is light, weighing only 3½ ounces and gives a brilliant illumination. These can be used in connection with the cells in the boxes.

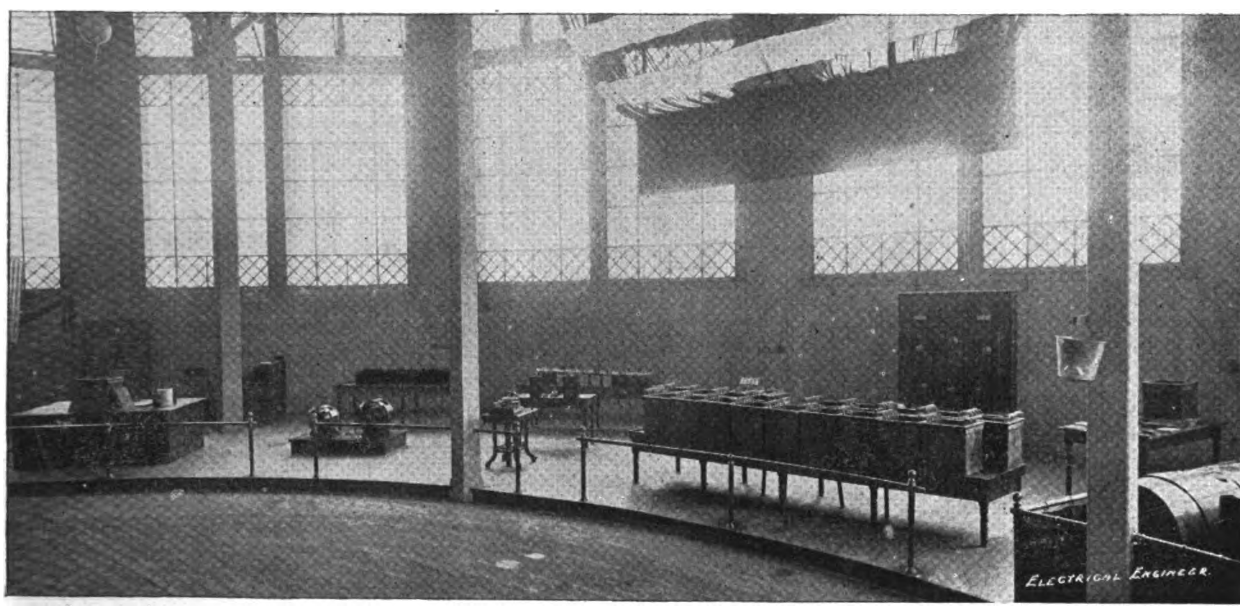


EXHIBIT OF THE UNION ELECTRIC CO. IN ELECTRICITY BUILDING.

The Main motor, also designed by Prof. Main, is exhibited and manufactured by this company. This machine although designed for direct currents has no movable wire in its construction. A 3 and a 5 h. p. motor are shown. They are very compact, light and of low speed.

Another branch in which this company are interested is the manufacture of "Electricon," an anti-friction or lubricating metal. It is said that practice has proven this metal to be cheaper than good babbitt metal, that it requires less oil, lasts longer, heats less, and stands heavier pressure, and that it will not flake or fuse.

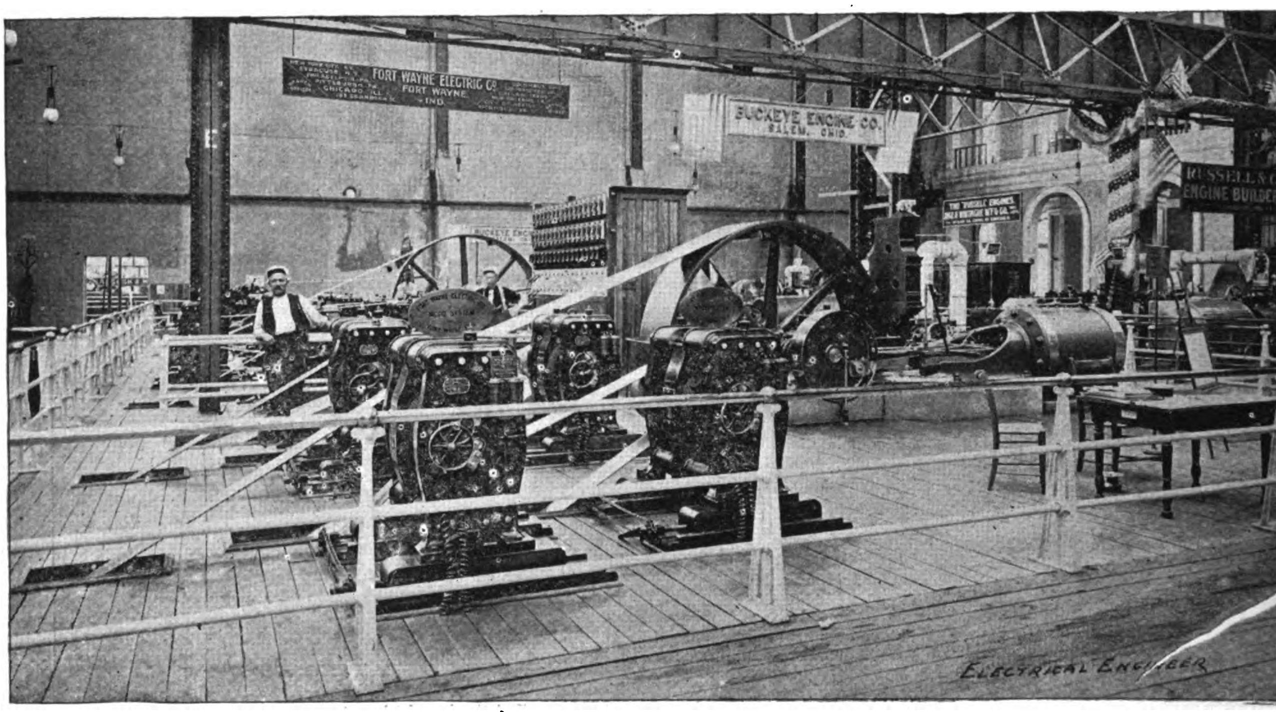
Associated with the Union Electric Company in their exhibit is the Fibre Conduit Company, whose exhibit consists of a conduit specially adapted to underground work and composed of spruce fibre and a preservative. The fibre is mixed with water and formed into a pipe or tube in "the white" on a machine invented by Prof. Henry Fairbanks, of St. Johnsbury, Vermont; it is then placed in a kiln until perfectly dry, when it is taken out and immersed in a bath of material to preserve it and render it waterproof. The finished pipe is strong and not only waterproof but unaffected by acids or alkali, and can therefore be laid directly in cement if necessary. The finished

pipe can be readily turned in a lathe and the joints made absolutely tight.

The Union Electric Company's display combines novelty with merit and attracts not only the general public but also the engineer and the electrician.

THE FORT WAYNE POWER PLANT.

The Fort Wayne Electric Company has been selected to furnish the current for the lamp tests about to begin in Electricity Building where a section in the southwest corner has been railed off by coarse wire netting through which the whole operation may be seen. During the whole course of the tests, from now until about the middle of September, 400 direct and 400 alternating current incandescent lamps will be run night and day without a pause. The generators and motors in the building which will be used for this purpose have already been described at length and it only remains to speak of the source from which they receive their power.



Arc Lighting Plant of the Fort Wayne Electric Co., World's Fair.

The complete power plant in Machinery Hall owned by the company contains fourteen 60-light arc machines and one of 80 lights besides one 160 h. p. 500 volt power generator. Thirteen of the 60 light arcs are used for the illumination of the northwestern corner of the grounds, the Midway Plaisance (or "Bowery," as it is now being called) the Casino pier and the 20 spar buoys marking the channel from the foot of Van Buren street to the Fair, and are under the control of the Exposition. The power generator, the 80-light and the remaining 60-light arc machine furnish current for light and power in the Electricity Building and are run by attendants in the employ of the company. The machines are operated by five Buckeye engines; one 350 h. p. cross compound condensing, two 125 h. p., and one 250 h. p. high pressure, and one 175 h. p. tandem compound. The two of the largest type are belted to two lines of shafting below the floor from which power is transmitted to ten of the 60-light dynamos by belts and friction clutches. Both shafting and pulleys are made by the Falls Rivet and Machine Co. The small engines are belted directly, one to three 60-light machines and the other to one 60 and the 80-light dynamo, while the tandem compound engine drives the power generator. There are also two motors of 1½ h. p. each, one driving a 22-inch ventilating fan and the other a Buckeye engine cut in a longitudinal section to show the working of all the parts.

Of the two switchboards in use, one is of white marble of the standard Wood type, arranged for 16 machines and 16 circuits with self-locking plugs and flexible cables. Each circuit is provided with an ammeter and polarity indicator combined and also with two Wood lightning arresters. The board is cased in and finished in yellow pine and all circuits are concealed within the casing. The other board is of marbleized slate and is used by the power generator alone. It is equipped with voltmeter, ammeter, two circuit breakers, a rheostat with discharge lamps and the necessary switch.

All of the apparatus in operation here has been upon the ground since last fall, and has spent the winter in damp storerooms, yet no trouble whatever has been experienced; and the entire plant has been running from the first in the most satisfactory manner. The private Fort Wayne section is in charge of E. Waterman, and E. H. Belden is in attendance upon the machines devoted to the Exposition lighting.

ELECTRICAL LECTURES AT THE FAIR.

The Department of Electricity has organized a course of free practical lectures or informal talks on electricity, to take place in Electricity Building, tri-weekly (Tuesday, Thursday, Saturday), from 2 to 3 p. m., by leading electricians and prominent exhibitors. These will be given in the Western Electric Company's scenic theatre. The programme for the first week from Aug. 8 is as follows:

Aug. 8. Electric Test Instruments, C. P. Frey, electrician E. S. Greeley & Co.

Aug. 10. Search Lights, F. W. Tischendoerfer.

Aug. 12. Fire Alarm and Police Telegraph, E. Bruce Chandler, of the Gamewell Co.

Other subjects to follow are: Electric Patents, Electricity in Mining, Electric Welding, Ocean Cables, The Telegraph, The Telautograph, The Phonograph, Long Distance

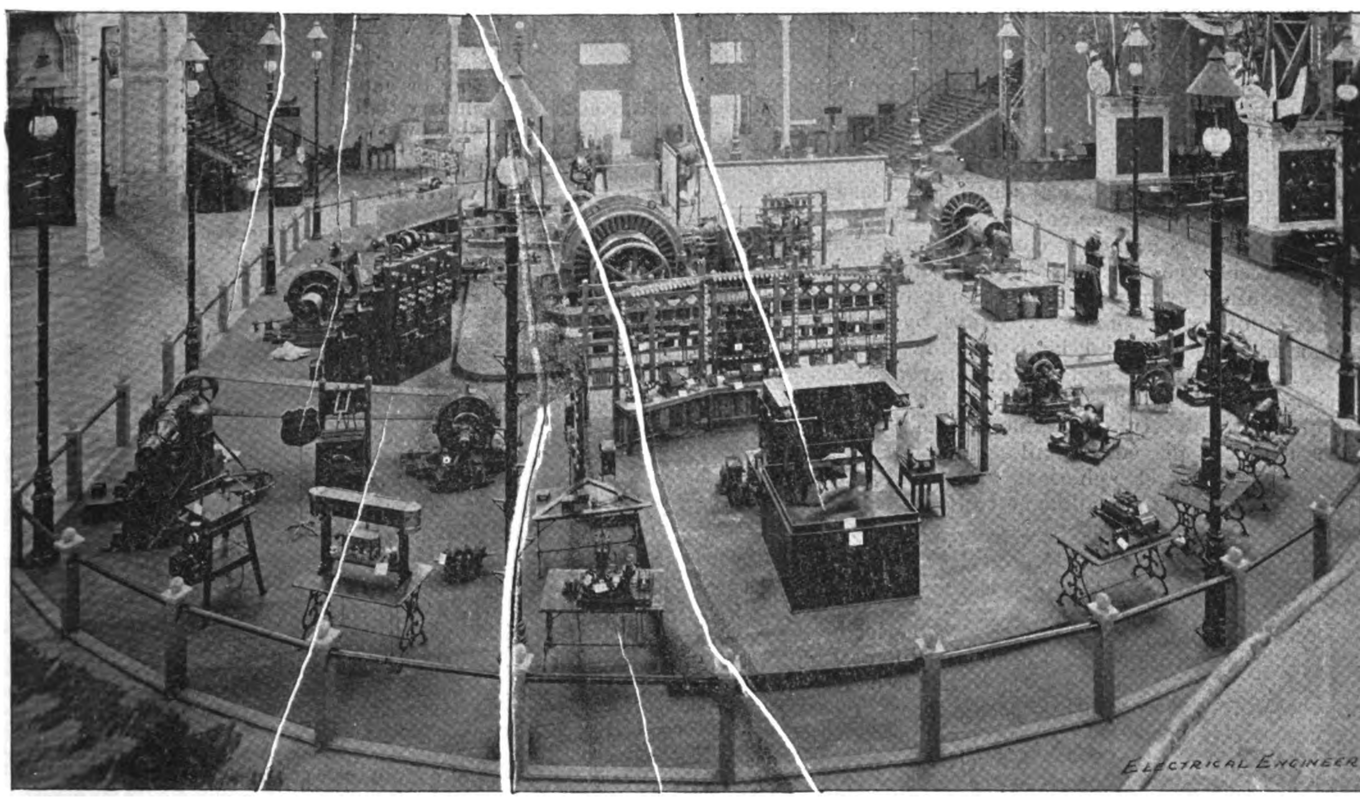
Transmission of Power, Primary Batteries, High Tension and Frequency, Electric Metal Working, Arc and Incandescent Lighting, Railways, Artistic Lighting. The full programme has not yet been made out.

THE THOMSON-HOUSTON EXHIBIT OF THE GENERAL ELECTRIC COMPANY.

The large space directly east of the tower of light in Electricity Building is devoted by the General Electric Company to their display of Thomson-Houston alternating and Stanley and Kelly two phase generators and motors, Thomson experimental apparatus, and an interesting exhibit of search lights and marine equipment. In the centre is a Thomson-Houston alternator directly coupled to a McIntosh, Seymour & Co.'s engine of 350 h. p., but not in operation, unfortunately, as no steam is obtainable in the building. It was at first intended to run it by compressed air, but the idea was abandoned. The dynamo has 40 poles and gives 1,040 and 1,154 volts at no load and full load respectively, the field being over-compounded to make up for drop in the line. Its speed is 180 revolutions a minute, frequency 120 a second, and its capacity 5,000 16 c. p. lamps. The armature is of the iron-clad ventilated type and the fields are movable.

At the right of this is a 300 kilowatt machine with 22 poles, designed for a speed of 682 revolutions with a capacity of 6,000 lights, run without load, of course, by a small exciter used as a motor, of about 10 h. p. At the right and left of the space are two Thomson-Houston generators belted to motors and in actual operation. That at the right is a 30-kilowatt machine running at 1,500 revolutions driven by a 35 h. p. motor, while the other is of 60 kilowatt capacity and is operated at the same speed by a 75 h. p. motor. Current from these is led to a model skeleton switchboard designed for four dynamos and four circuits and equipped with Thomson wattmeters, station transformers, voltmeters, ammeters, rheostats for the fields of exciters and alternators, and at the back, ground detectors and lightning arresters. From the board the current is distributed to the meter-room of the General Electric Company at the opposite side of the building, the Ansonia Electric Company's exhibit in the north gallery, the L. J. Wing, and the Excelsior exhibits and to the series lighting display and the Thomson experimental apparatus in the same space.

Just back of the 60-kilowatt generator is a 120-kilowatt 2,600 light alternator, not running, and near-by are two large banks of transformers ranging from 300 to 30,000 watts, surmounted by a row of "dimmers" for theatres, while above the whole are two boards with lamps showing the series system of lighting. These lamps are of 25 c. p. connected 50 on a circuit and arranged so as to spell the words "Series" on one board, and "System" on the other. At the backs of the stands supporting the transformers and induction coils are the regulators for keeping the series lamps at the proper point of brilliancy by cutting in or out other lamps to compensate for a too small or too great resistance in the line.



THE THOMSON-HOUSTON EXHIBIT OF THE GENERAL ELECTRIC COMPANY.

At the rear of the series lighting exhibit is a two-phase generator of the General Electric Company's make, driven by an Edison 30 h. p. motor. Part of its current is used for about 80 incandescent and two arc lamps, the former arranged in the two large spheres supported on pillars for ornamental lighting, and the rest operates a two-phase, 7 h. p. Stanley and Kelley motor belted to a Sturtevant blower that ventilates the tower of light. Two 4 h. p. and two 2 h. p. two-phase motors are also shown but are not in operation. The principle of these machines has been already fully described and illustrated in THE ELECTRICAL ENGINEER of April 26.

A number of search lights, both automatic and hand controlled, are shown, ranging from 12 to 30 inches in diameter, including one recovered from the sunken United States ship "Trenton" at Samoa, the first ever used on board a United States man-of-war. Besides these, there

is a 6,000 c. p. lamp with a white enameled, instead of a silvered, reflector for photographic and blue print work. A 15-kilowatt multipolar generator directly connected to a Case engine, and a four-winch hoist driven by a 40 h. p. motor and the whole enclosed in a waterproof iron casing occupy positions at the extreme right of the rear space.

All manner of naval and marine lights and wiring systems are shown on a large board near by. Here are deck and bulkhead lights, war lanterns, port, starboard and masthead lights, fixtures for cabin and hold, steamtight and watertight globes for deck and boiler room, moldings, tubing, etc., and suspended from the roof of the building so that the lowest light is only a few feet above the heads of people. In the exhibit space is an electric signal set for use at sea, consisting of five double lanterns several feet apart, each lantern half red and half white, and each half provided with a separate and independent incandescent lamp. The apparatus is controlled and operated from any distance by a switch on which are indicated the various combinations of which the system is capable.

The front of the space next the main aisle is occupied by a collection of Prof. Thomson's experimental apparatus, the chief of which is that for producing high voltage discharges, already described in these pages. A spark 64 inches in length can be obtained by this apparatus but one of only about 48 or 50 inches is shown here, owing to the great strain of the longer one upon the condensers. Horizontal and vertical repulsion coils and their well-known effects are shown and always attract a large crowd of spectators. An arrangement for regulating the pressure of the secondaries is shown, consisting of a reactive coil of variable resistance whose secondary winding is cut in or out as required by a small motor run in either direction by the action of a repulsion coil. Near by is a photometer with a floating coil and lamp capable of adjustment to standard brilliancy, and a three-carbon arc lamp requiring less than 30 amperes on a 110 volt circuit but giving a powerful light almost wholly in one direction. On a stand is placed a small arc generator built in 1880, containing the first spherical armature ever made, and bearing a striking resemblance to that used in the Thomson-Houston machine of to-day. Various other old machines of different types are exhibited and are interesting as showing how little the development of the type has altered the original design. Beside the generators are several forms of lamps and switches, a series motor with a speed regulator and a number of experimental meters and magnets. No piece of apparatus in the historical collection, however, is more interesting than the prototype of the modern "T.-H." arc lighting machine. It was wound in 1879 by Prof. Thomson himself and was first used to light the "Philadelphia Bakery."

The entire display is most interesting and striking, showing, as it does, side by side, so much that is old and new. The alternating exhibit, the motors and two-phase machines, and the display of Prof. Thomson's apparatus are in charge respectively of Messrs. Edgar A. Carolan, J. S. Tritle and A. Howland.

SALES OF BRUSH WORLD'S FAIR APPARATUS.

The 30,000 light switchboard forming part of the exhibit of the Brush Electric Company in the Electricity Building has been sold and will form part of a new electric plant to be erected in Manilla, Philippine Islands. Ten alternators and four 65 light arc machines have also been bought for the same station.

The Edison Light and Power Company of San Francisco have bought 300, and the Indianapolis Light and Power Company 100 of the double carbon lamps now on exhibition in the same space.

Mr. J. W. Kirkland, of the Thomson-Houston International Electric Company, is at the Fair taking charge of the foreign interests of the company at the Exposition.

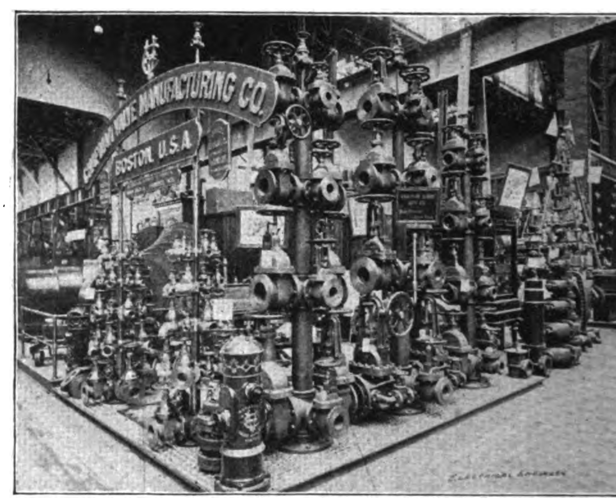
RECEPTION BY THE ALLGEMEINE ELEKTRICITÆTS-GESELLSCHAFT.

The elaborate exhibit of the Allgemeine Elektricitäts-Gesellschaft in the Electricity Building has been placed *hors concours*, as the Director-General of the company, Herr Rathenau, preferred the honor of serving as one of the judges of awards to the pecuniary benefit that might accrue from a prize given to the company's apparatus. In order that the excellence of his display might not be lost sight of, however, Herr Rathenau gave a private view of the exhibit to the judges and representatives of the technical press on Tuesday, August 8, at six o'clock in the afternoon. The Director-General received his guests and made a tour of the exhibit with them, explaining the apparatus and pointing out its peculiar claims to superiority, after which a high frequency discharge of champagne corks took place with the most satisfactory results.

It will be remembered that this exhibit was fully described and illustrated in The Electrical Engineer of August 2.

CHAPMAN VALVES AT THE FAIR.

For managers and engineers of central power stations, the display of straightway or gate valves shown at "K—28," on the centre aisle, in Machinery Hall by the Chapman Valve Manufacturing Company, whose works are at Indian Orchard, Springfield, Mass., will prove both interesting and instructive, and well worthy of careful examination. One noticeable feature of this display is that the valves shown are taken from regular stock and



The Chapman Valve Exhibit.

not highly finished for the occasion, so that the visitor gets a correct idea of the quality of material and workmanship put into their goods by this well-known company.

Recognizing the tendency to increase the pressure of steam carried in the power plants recently erected, this firm call the attention of engineers to their complete display of valves and flanges, especially designed for this class of work, and which have so fully met the severe demands made upon them. Among the special features shown as applied to the Chapman high pressure steam valves, with renewable bronze seats, are the outside screw and yoke, the by-pass arrangement, the ribbing of the body, that it may not be affected by the expansion of the pipe line, and the self-packing feature on the spindle, by means of which the valve may be packed when wide open with the steam on the line. Both tongued and grooved, and plain flanges especially designed for high steam work are shown, and may be used either bolted to the valve or as flange unions. These valves may be seen in actual service as throttle valves on the E. P. Allis Manufacturing Co.'s quadruple expansion engine, the largest in Machinery Hall; as boiler stop valves on the Heine boilers in the boiler house annex and at the power house of the Intramural electric railway. This latter plant is fitted throughout with both high and low pressure valves made by this company.

Being limited in space in Machinery Hall, the company only show valves from ¼ to 24 inches in size, although they make as high as 48 inches. In addition to those mentioned, are shown a

complete set of brass and iron valves for feed and circulating systems, and exhaust and low pressure steam, ammonia valves for mechanical refrigeration, and valves and fire hydrants for use on water systems.

The display is arranged in such a way that each valve may be easily examined, and shows all varieties of end connections, methods of opening, indicating devices, etc., in a very attractive and appropriate manner. Valves for like purpose are bolted or screwed to brass or iron masts, or shown in pyramids of graduated sizes. The company's representative, Mr. Edward L. Ross, M. E., spends his time at the exhibit in Machinery Hall, and is always pleased to explain the valves to interested visitors.

OFFICIAL DELEGATES TO THE INTERNATIONAL ELECTRICAL CONGRESS.

As the time approaches for the assembling of the World's Congress of Electricians the following items may be of interest. It will be remembered that at the meeting of the Advisory Council held January 17 last, several committees were appointed and among others a committee to decide upon the number of members that each foreign country should be invited to send to sit in the chamber of Delegates.

Their apportionment was as follows:

Five each for: England, France, Germany, Austro-Hungary and the United States. Three each for: Belgium, Italy and Switzerland. Two each for: Norway and Sweden, Holland, Denmark, and Spain. One each for: Portugal, British North America, Russia Australian Colonies, India, Japan, China, Mexico, Brazil, Chili, Peru, and the Argentine Republic, making 55 in all.

Up to the present moment eight of the more important countries have officially responded to the call. We give below the names of the delegates in the order of their official appointments.

ENGLAND: W. H. Preece, F. R. S.; Prof. W. E. Ayrton, F. R. S.; Prof. S. P. Thompson, D. Sc., F. R. S.; Alex. Siemens; Major Cardew, R. E.

FRANCE: M. Mascart, M. Hospitalier, M. Violle, M. de la Touanne.

GERMANY will be represented by Dr. H. von Helmholtz, who requests that the following gentlemen of the Physikalische-Technische Reichsanstalt, of Charlottenburg, be allowed to attend the meetings of the Chamber of Delegates, namely: Dr. Feussner, Dr. Kurlbaum, Dr. Leman, Dr. Lindeck, Dr. Lummer and Dr. Pringsheim.

UNITED STATES: Prof. H. A. Rowland, Prof. T. C. Mendenhall, Dr. H. S. Carhart, Prof. Elihu Thomson, Prof. Edward L. Nichols.

SWITZERLAND: M. le Dr. A. Palaz, M. Thury, M. le Dr. Weber.

ITALY: Prof. Galileo Ferraris.

MEXICO: Senor Don A. M. Chavez.

CHINA: Mr. Peng Kuang-Yu, Mr. Teng Shen, Mr. Shon Yen.

In addition to the above Dr. Gray has received the following unofficial announcement in regard to AUSTRIA:

"In response to the invitation extended to it to participate in the Electrical Congress to be held in Chicago, the Electrotechnicher Verein of Vienna, has appointed the following of its members delegates to represent it at the meetings: Nikola Tesla, A. Prosch, Inspector of Austrian State Railways, Ernst Egger, Dr. Johann Sahulka, Constructor at the Imperial High School, Vienna, Fred. W. Tischendörfer and Joseph Wetzler."

Whether it is intended that five of the last named gentlemen shall sit in the chamber of Delegates or not, we have no means of knowing. This question as well as the request of Dr. H. von Helmholtz in respect to his confréres and the fact that China has appointed three, whereas only one was requested, will have to be referred to the committee on credentials at the opening of the Congress.

About a thousand invitations in all have been sent out and from the number of acceptances that are coming in there is every reason to believe that the Congress will be well attended.

THE TRANSPORTATION ARRANGEMENTS FOR THE INTERNATIONAL ELECTRICAL CONGRESS.

ARRANGEMENTS have been perfected with the New York Central & Hudson River Railroad Company for the transportation of delegates from New York and vicinity on the following schedule:

Leaving Grand Central Station 7.30 p. m., Saturday, August 19th; arriving at Niagara Falls the following morning for breakfast, where also a few hours will be spent in sight-seeing; resuming journey in the afternoon, and reaching Chicago early Monday morning, August 21st.

The round trip rate is $43.00. It is essential that all delegates desiring to join this special party communicate at once with C. O. Baker, Jr., 186 Liberty street, stating the number of tickets and space desired in the sleeping cars.

TO INSPECT THE NIAGARA FALLS TROLLEY RAILROAD.

MR. W. A. GRANT, the general manager of the Niagara Falls Park and River Railway Company, has extended an invitation to the Eastern members of the Electrical Congress passing through Niagara Falls on Sunday, August 20, to inspect and ride over his fine electric road which parallels the Niagara River on the Canadian side for 12 miles and takes in every point of interest, giving an uninterrupted view of all the magnificent scenery from the upper rapids all the way down to Queenston on Lake Ontario. The invitation has been accepted by Mr. C. O. Baker, Jr., master of transportation, and after the arrival at Niagara Falls on Sunday morning and breakfast, the party will proceed to avail themselves of Mr. Grant's courtesy, which will add greatly to the pleasure of the trip to Chicago on this occasion. It may be mentioned that this road is the first electrical utilization of the Niagara water power on the Canadian side. The power house is unusually interesting.

ARRIVAL OF MESSRS. PREECE AND SIEMENS.

Mr. W. H. PREECE, chief engineer and electrician of the British Postal Telegraphs, and Mr. Alexander Siemens, of London, arrived in New York on Saturday, August 12. They will spend a few days in the city and will proceed to Chicago towards the end of the week. Both gentlemen are official delegates to the Electrical Congress. Major-General C. E. Webber, another English delegate, is expected within a few days.

LEGAL NOTES.

EDISON LAMP LITIGATION.

WHILE the Edison lamp suits against the Mt. Morris and Union Electric Light Companies in New York have been laid over until September, the fight has brokenout in Detroit. The Edison Electric Light Company, of New York, and the Edison Illuminating Company, of Detroit, have brought suits against the Huyett & Smith Manufacturing Company and the Detroit Confectionery and Fruit Tablet Company to compel them to abstain from alleged infringement of the Edison incandescent lamp patents and to collect damages for past infringements. Other suits are threatened and the policy of exasperation is in full swing.

OBITUARY.

LOUIS W. BURNHAM.

LOUIS W. BURNHAM, vice-president of the Electric Gas Lighting Company, died at his home, Dorchester, Mass., on Aug. 9, from paralysis. He was 62 years of age. He was born in Canterbury, Mass., April 17, 1831. In his earlier life he was Professor of Penmanship in Burnham's Business Colleges, which he founded in Rockford, Ill. and Springfield, Mass.

He went to Boston in 1870, and for a time engaged in the insurance business, having previously been employed by the Union Mutual Insurance Company at Worcester. About ten years ago he started with Mr. John M. Barker in the highly successful enterprise now known as the Electrical Gas Lighting Company, whose offices are at 195 Devonshire street, Boston. Mr. Burnham was president of the company for the first two or three years of its existence, and afterward assumed the more arduous duties of vice-president and general manager, being succeeded in the presidency by Mr. Joseph S. Fay. Mr. Burnham had been vice-president of the company for seven years. He leaves a widow and three children, a son, Mr. W. W. Burnham, treasurer of the Electrical Gas Lighting Company, living at Newtonville, and two daughters. Few men were better known in the electrical field than he, and in spite of his marked individuality few men were better liked. He will be greatly missed.

A WESTINGHOUSE ALTERNATING ELECTRIC RAILWAY SYSTEM.

WILLIAM L. ELKINS, JR., of Philadelphia, has been looking into a system of underground electric railways, it is said, which Mr. George Westinghouse, Jr., has contrived. Instead of using the continuous current the alternating will used. A pair of high tension lines will be laid along the line, and the current will be reduced to a safe working pressure by converters and fed into short sections of the railway conduit, so that in the first place, there will be no traveling of the current over long distances, and, secondly, the current being of the alternating character, it will not produce the electrolytic action which seems to be the occasion of destruction to iron and lead pipes.

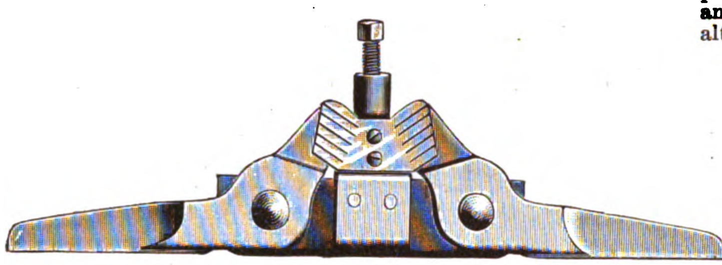
Mr. Westinghouse says that a big railway company in a large Eastern city has already contracted to put the thing into practical operation.

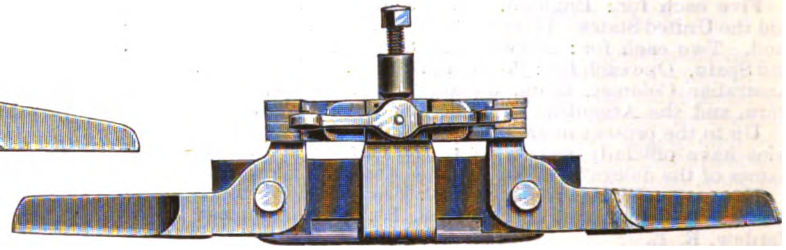
ELECTRIC RAILWAY DEPARTMENT.

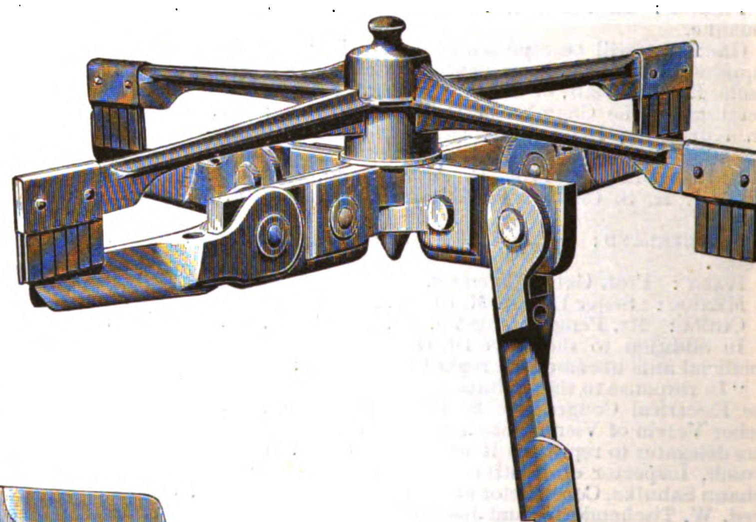
THE SCHEFBAUER "SAFETY" OVERHEAD TROLLEY FITTINGS.

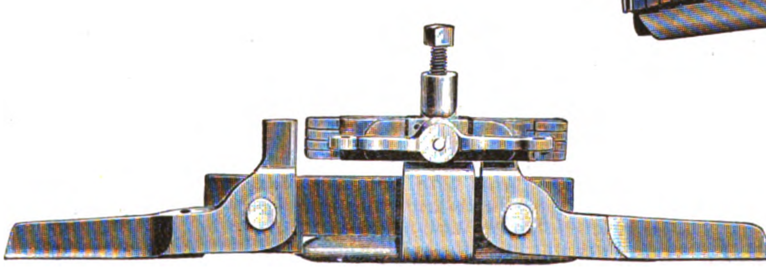
In a recent issue we gave a brief description of the overhead trolley fittings, built by Mr. R. Schefbauer, of Paterson, N. J., and designed to establish the safety of the line under all conditions. We are now enabled to illustrate these devices.

The automatic circuit breaker shown in Fig. 1 consists of an insulating block at the ends of which are pivotted two levers. One end of each of these levers passes between a pair of clips to which the feeder wire is connected, forming in effect a knife switch;









Figs. 1, 2, 3 and 4.—The Schefbauer "Safety" Overhead Trolley Fittings.

while the other end, which extends horizontally holds the trolley wire, being provided with a groove on its lower edge. From its construction it will be evident that if the trolley wire should break or sag beyond its normal amount, the upper end of the lever, or knife edge will be pulled out of the clips and thus effect the breaking of the circuit. This circuit breaker is intended to be put on roads having heavy traffic and to cut out sections of from 100 to 120 feet in length.

The straight line circuit breaker, designed by Mr. Schefbauer, is shown in Figs. 2 and 3, the former showing it with the contacts closed and the latter open with the circuit broken. The principle embodied in this apparatus is analogous to that just described, only in this case, the break is effected in a straight line. This circuit breaker is intended to be placed at distances of 1,000 to 1,500 feet, and breaks the circuit at two points, by a sliding motion.

The Schefbauer insulated cross-over, illustrated in Fig. 4, consists of two pairs of arms which can be placed at any angle, and which are insulated from each other. Each arm carries a clip into which fits a knife blade forming the upper part of the lever to which the trolley wire is attached. Upon the breaking of the trolley wire the arm with its knife blade is pulled down, and the circuit broken. This cross-over is very easily adjusted and maintains perfect insulation between the trolley wires.

REGULATING THE ELECTRIC RAILWAY WATER POWER AT OTTAWA, CAN.

In the operation of electric railway power stations by water power, much difficulty has been encountered in the regulation of the speed of the machinery to meet the rapid fluctuations of the load, owing to the inertia of the water and the slow action of the water-wheel gates. The different methods of governing the wheels have proved to be so unsatisfactory in many cases that automatic governors have been abandoned and the expedient resorted to of keeping the load on the generators constant. This is accomplished by means of an artificial load formed by a variable resistance connected across the terminals of the generators, which is altered so as to keep the output constantly at its maximum.

Such a method however, is very wasteful of the water power, and is besides open to the objection that the machinery is always worked to its fullest capacity and is thus subject to the greatest amount of wear and tear. After being in use for a short time in the station of the Ottawa Electric Street Railway Company, at Ottawa, Canada, this method was replaced by a system of hand regulation of the water wheels, devised by the employees of the company, which has given great satisfaction. By this system, the speed of the wheels is regulated by an attendant who is constantly on duty and who opens or closes the gates and thus varies the quantity of water supplied the wheels to suit the load.

The power plant at this station consists of two 400 h. p. multipolar Westinghouse generators, belted to a countershaft driven by two turbines. The shaft is in two parts connected by a clutch so that any one of the generators and of the turbines may be run together. In fitting up the new system, the ordinary gates were removed from the turbines, which are of the vertical type with inlet openings in their peripheries, and replaced by others. Each of these new gates consisted of a cast iron ring of such a diameter as to fit close to the inlet openings when placed around the wheel. One of the rings was suspended horizontally in the wheel pit over each turbine and balanced by weights attached to chains which were wound around drums on a shaft. When the shaft is turned, the chains are wound upon or unwound from the drums accord-

ing to the direction of rotation and the gates are thus raised or lowered. To shut down the machinery, the gates are lowered till they rest upon the floor of the wheel pit. They then surround the turbines and close the inlet openings, thus stopping the entrance of the water.

Connected with the shaft, which operates the drums, is a pulley mounted upon an eccentric and located between two friction wheels continuously driven in opposite directions by the machinery. By means of a hand lever attached to the eccentric, the attendant can bring the pulley into contact with either of the friction wheels and in this way cause the shaft and drums to rotate in either direction and raise or lower the gates as desired. A voltmeter showing the pressure on the line is placed opposite the hand lever and, guided by its indications, the attendant on duty raises or lowers the gates as needed to keep the voltage normal. Two attendants are on duty in the station at the same time and take turns of a half hour each at the regulator. For emergencies, such as the opening of all the circuit breakers from trouble on the line or when there is a very large fluctuation in the output which is too rapid to be controlled by the hand regulator, a rheostat of iron wire is provided, which can be cut into or out of the line by a Westinghouse car controller adjacent to the hand lever. The gates can also be opened and closed by hand independently of the mechanism described.

A very important advantage of this system is, that, if anything goes wrong it cannot fail to be detected at once by the attendant, who is of necessity constantly on the alert.

CONSTRUCTION OF ELECTRIC CAR BARNS.

BY

The prevention of fires in electric railway car barns deserves the most careful consideration at the hands of street railway companies and fire underwriters. To the former it is more important than to the latter, as theirs is the original investment in building, tracks, rolling stock and equipment, theirs is the loss in the difference between the cost of the cars and equipments and the amount recoverable by insurance, and theirs is the loss of revenue during the time new cars are being built. The last named loss may easily exceed the entire value of the cars and equipments.

It may be stated as an axiom that no company should house all its cars in one barn. There should be different barns widely separated, the number depending, of course, on the total number of cars operated. The barns should undoubtedly be in the outskirts of the city, where plenty of room can be had cheaply for curves and sidetracks outside of the building. On the other hand, the barns should not be too far out in the country, away from police protection and where it would take an excessive amount of time for the fire department to respond to a call.

All barns in addition to being as fireproof as possible, should contain fireproof partitions, of corrugated iron, say, running the entire length of the building, parallel with the tracks, and enclosing two or more tracks, according to circumstances. These partitions would contain iron doors, to be closed after the cars are run in at night, and opened in the morning, or only when required. The partitions should extend five or six feet above the trolley wires.

As to the proposition to build the tracks in car barns with a grade, I agree with Mr. Gutmann[1] that it would be very inadvisable. I have in mind one car barn in which, to save the expense of building repair pits, lined with cement, which would have been necessary owing to water being found 12 inches below the surface, the tracks were raised on timbers about 3 ft., 6 in., and inclines built from the street to them. It has been found to be an intolerable nuisance to handle the cars on the inclines. Of course, these particular inclines were not built for the purpose of getting the cars out in case of fire, but they indicated to me the great inconvencience of inclined tracks in car barns, and I have therefore advised against a proposed similar arrangement in a large barn we now have under construction in New Orleans. Inclined tracks would certainly be almost useless where turntables are depended on to get the cars out.

The following arrangement, under certain circumstances would be found advisable. In a barn closed at the rear end the tracks might be inclined, from rear to front, with a grade just sufficient to allow the cars to roll. At the rear end of each track a stout post, with hitching chain, would be erected. This chain would be hooked into the draw bar of the first car run into the barn. The second car would be run up to the first, and the draw bars connected together, the third to the second, and so on, until the track was filled up.

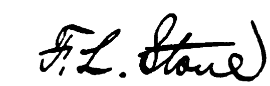
In a barn open at both ends the tracks would be inclined from the centre of the building outwardly. The first car would then be run into the centre of the building, on the top of the incline, and the brake set. The next two cars would be run up one on each side of the first, and coupled to it, the other cars following up in equal numbers on each side. The brake could then be let off the centre car, as the weight would be equally divided on the two sides, and the cars of course would not move. In case of fire, all that would be necessary would be to uncouple the cars one at a time, beginning at the foot of the incline, and run them out. This arrangement would do away with the necessity for having the brakes set, or scotching the cars.

However, "Prevention is better than cure," and it is better to adopt precautions against fire, than remedies for use after it has broken out.

1. The Electrical Engineer, July 19, 1893.

SUGGESTIONS ON CAR HOUSE CONSTRUCTION.

BY



The problem in car house construction discussed in these columns by Messrs. A. E. Braddell and L. Gutmann (July 5 and 19) might be solved by a transfer table built on the plan of the endless floor horse power, operated by motor, and having tracks on the table for all the tracks in the building. Thus when one table track is in line with one car house track all the others are in line also. Then employ graded tracks or depend upon the current to run the cars out in case of fire; with either of these means the transfer table does not blockade the cars.

MAGNETIZATION OF STEEL RAILS.

M. Vinot, a French engineer, has contributed to *L'Industrie Electrique* the results of some experiments made by him in regard to the magnetization of steel rails. M. Vinot took for his experiments a portion of the line of the Compagnie du Midi between Bordeaux and Cette, the left-hand track serving for the trains coming from the latter town, while on the right-hand track the trains run in the opposite direction. On the experimental section chosen the rails were laid in a direction at right angles to the magnetic meridian, or, in other words, from west to east, and it was found that when a pocket compass was placed on one of the joints of one of the lines of rails of the left-hand track, the needle pointed exactly in the direction of the line of rails, the north pole being turned toward the town of Cette. With the same compass similarly placed on the right-hand track the needle again pointed in the direction of the line of the rails, but the north pole this time was turned toward Bordeaux. The distances between the rail ends varied from about $\frac{1}{16}$ to $\frac{1}{4}$ inch producing a very perceptible shock on the passage of trains, due to the respective depressions and elevations of the ends of the rails and their influence on the car wheels, and these shocks, it was concluded, developed a south polarity in those rail ends in which the concussion took place.

TROLLEY MAIL CARS AT OTTAWA, CAN.

An order-in-council has been passed by the Ottawa Government, authorizing the post-office department to go into a contract with the Ottawa Electric Street Railway Company for the conveyance of Her Majesty's mails between the post office and the railway stations. The amount of the contract is $4,000 per year. The cost of the present horse and van system is from $3,800 to $4,000 per year with extras.

THE "BLUE PRINT STEAL."

Messrs. Niles & Carr, of Lynn, solicitors for the General Electric Company have filed in Salem the answers to the bill in equity filed against the General Electric Company, the Thomson-Houston Electric Company, and E. W. Rice, Jr., and W. H. Knight, in the supreme judicial court at Salem, May 6, in which the plaintiff charges the defendants with bribery and instigation of theft in securing plans and blue prints from the Westinghouse Company, that the defendants might take advantage of the plaintiff in competition, and charging them with concealing and removing from the offices of the Thomson-Houston Electric Company plans and prints that were in possession of the defendants, that the said property might not be recovered on a writ of replevin served May 5. The answers are three in number, one for each defendant, and deny all charges, although admitting that in the possession of the company there may have been various prints of apparatus manufactured by the plaintiff but secured in the ordinary course of business, without wrongful action on the part of the defendant.

Miscellaneous.

AN AMERICAN ELECTRIC LAUNCH FOR THE GRAND DUKE ALEXANDER.

While being entertained by Mr. J. J. Astor, at Rhinebeck, N. Y., a few weeks since, the Grand Duke Alexander, of Russia, was much pleased with an electric launch that had been constructed for Mr. Astor a few months previous. At that time he learned that a similar boat had just been completed by the General Electric Launch Company for the U. S. Government cruiser "New York," to be used as the Captain's gig. He shortly afterwards had an opportunity to inspect this electric gig, and took such a fancy to it that, at the request of the Department of State, the Navy Department directed the contractors to deliver the launch to him and to begin the construction of a duplicate for the cruiser "New York."

This electric gig, which we illustrate in the accompanying engraving, is 30 feet long, 6 feet 8 inches beam, and 22 inches draft. It is equipped with 66 storage batteries capable of delivering 8 h. p. to the motor for a period of 10 hours with one charge. The motor normally has a speed of 650 revolutions at 8 h. p. and is able to propel the boat at a speed of 6.4 miles per hour. The motor, however, is capable of developing 12 h. p. for a spurt of 5 or 10 minutes, increasing the speed of the boat to about 10 miles an hour. The batteries are placed underneath the seats and beneath the flooring, leaving the entire boat space for passengers. The motor is placed near the centre of the boat and underneath the flooring, being directly connected to the propeller shaft. The controller for regulating the speed is located near the wheel.

Electric Launch for the Grand Duke Alexander.

The launch was delivered last week to the Grand Duke in person, who, after a careful inspection and testing of the boat, accepted the same, and had it hoisted upon the davits of the flagship "Dmitri Donskoi." The flagship is now on its way to Kronstadt and St. Petersburg. The launch will there be transferred to the royal steam yacht, and will be for the personal use of the Grand Duke in his cruises around the Russian bays and waters.

EDISON'S SHREWD DEFINITION OF THE FINANCIAL TROUBLES.

Concerning the partial shut down at the Edison Phonograph works, Thomas A. Edison has issued this letter: "The phonograph works have been shut down because we have nearly completed all the orders on hand, and the proprietor thereof, seeing that the country had resolved itself into a national lunatic asylum, decided to wait until the wave subsided somewhat."

ELECTRICITY IN RIO.

Brazilians at the Fair say that it is thought, that as soon as the present contracts with the gas companies expire, the entire city of Rio de Janeiro will be lighted by electricity. The public buildings have already adopted electricity. The street railway trolley systems are also rapidly being extended.

Letters to the Editor.

LORRAIN'S "CARTESIAN DIVER" GALVANOMETER.

Permit me to correct an error in the description of my "Cartesian diver" galvanometer in your issue of Aug. 2. It is not the air within the stem of the diver (which for my purpose I shape like an ordinary hydrometer) that is heated, but the air above the water and surrounding the stem. The increase of pressure produced in this air is transmitted through the water surrounding the diver and through the water in the weighted bulb to the air within the stem. This air being in consequence compressed, occupies less space, so that more water passes through the hole into the bulb, and, the diver becoming heavier, sinks. Thus the diver, instead of rising with increase of current, as your description would imply, sinks as the current increases.

As a matter of fact, I have not graduated the stem in amperes but only empirically for rough demonstration purposes. Whether or not the instrument could be made into a good ammeter I have not yet determined; but I should be more hopeful of it as a voltmeter. I may perhaps add that I devised the instrument in January, 1888.

J. G. Lorrain.

Chicago, Ill., Aug. 5, 1893.

THE STORY OF A CABLE BUOY.

In your number for June 14 last appeared an illustration accompanying Mr. A. E. Kennelly's "Reminiscences of Sir James Anderson." Perhaps your courtesy will permit me, as the artist who accompanied the Atlantic Telegraph Expeditions of 1865 and 1866, to say that the illustration you give is reproduced from a photograph of a picture painted by me in 1865 for Sir James Anderson, who, not long before his decease, showed me one of the excellent photographs taken from it. The photograph, however, cannot correctly be called "an original," as, of course, only the picture can be so termed. It was in the Royal Naval Exhibition of 1891. I am induced to write a few lines to supplement the short description given beneath your illustration.

The story told by the picture has a great point of interest in the buoy in the foreground (or forewater)—the disadvantage pictorially of this object having, from its prominence, a tendency to dwarf the ship, is counterbalanced by the interest of the story of the buoy. It had been lowered from the bulwarks of the great ship, and was anchored, so far as almost exhausted means of tackling would permit, at a depth of some 2¼ miles, to mark the spot where the electric cable had gone down, and were lay buried—then—so many and such sanguine hopes.

A sketch of mine of this buoy appeared in the *Illustrated London News* of September 2, 1865. The buoy itself, driven by the storms of the succeeding winter into far distant seas, was—as I saw subsequently mentioned in some paper—discovered by the captain of a ship at sea and identified by that sketch.

The ship in the offing is H. M. S. "Terrible," the consort of the "Great Eastern" in the memorable expeditions of 1865 and 1866. The scene, in fact, pictures the parting of the ships over the grave of the lost cable.

No doubt all these particulars bear especial interest for those in whom the memory of the events is still living and keen; but any record of such enterprise must possess some interest for all—even after many years.

Robert Dudley,
31 Lansdowne Road, Notting Hill, London.

July 18, 1893.

THE GOEBEL LAMP, NO. 9.

In your editorial on the Oconto lamp decision, in the last paragraph you state: "The discovery of another lamp like Exhibit No. 4, with an unimpeachable pedigree running back of 1879, would at any moment put an entirely new phase upon the case."

You seemed to have entirely overlooked lamp No. 9 in writing this article, which was introduced for the first time in the Columbia case. If you will refer to the testimony you will see that here is another lamp almost exactly the counterpart of lamp No. 4, which is established by at least six competent witnesses as having been in existence before 1879, by reference to the evidence of John C. Goebel, Baldwin and Ida Sebastiana, Johanna Pasbach, Geo. Pasbach and others.

In the face of all this testimony it seems to me improbable that the proof is not clear, convincing and beyond a reasonable doubt. I have only called your attention to these matters as I have thought that perhaps you may have overlooked them in writing your editorial, and if you desire to mention them at any future time you can have the facts before you.

J. H. Rhotehamel,
President Columbia Incandescent Lamp Co.

St. Louis, Mo., Aug. 4, 1893.

THE LATEST LARGEST SEARCH LIGHT IN THE WORLD.

THE GENERAL ELECTRIC COMPANY has just finished the largest and most powerful electric search light in the world, now being

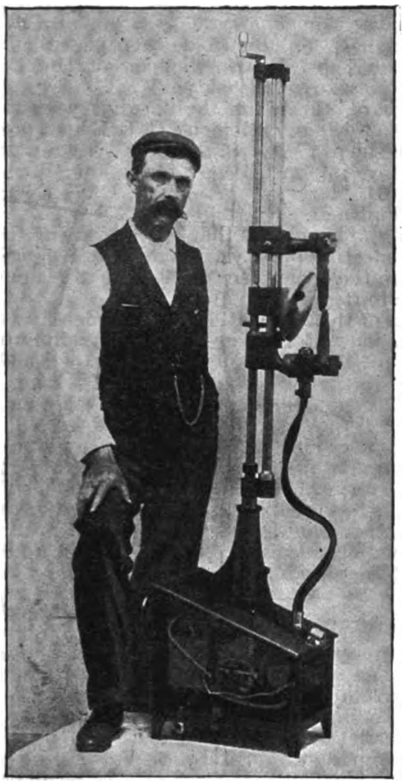
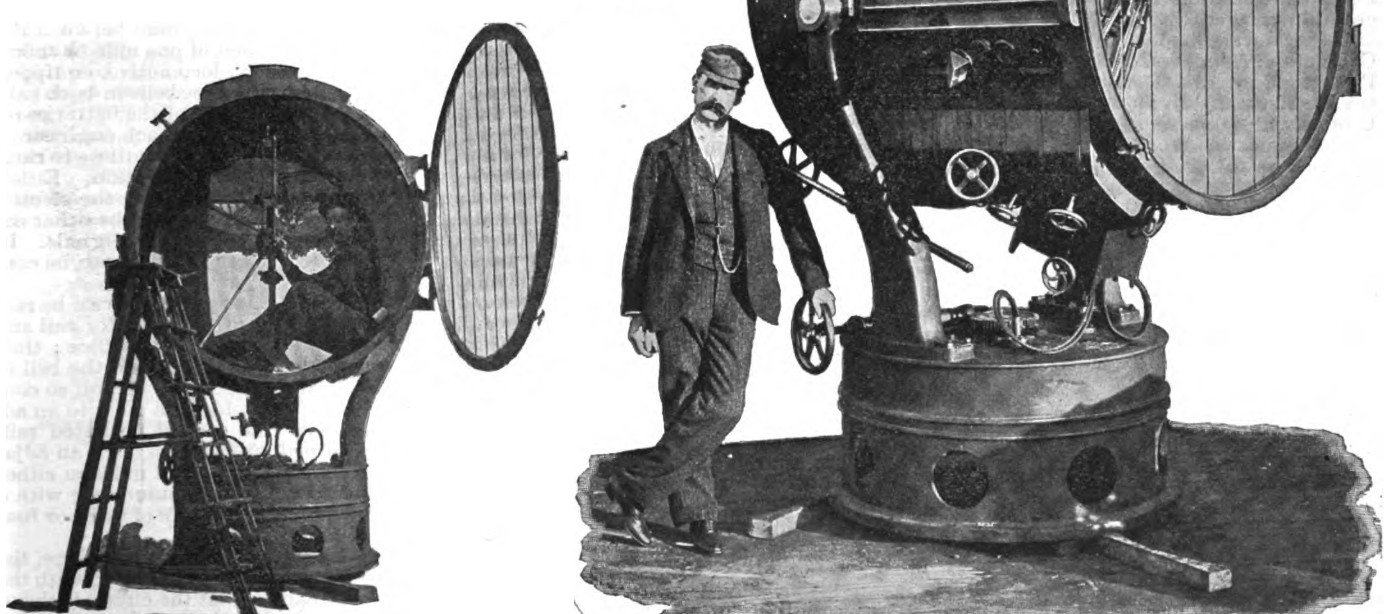


FIG. 1.—MECHANISM OF LAMP.

set up at the World's Fair. Some idea of its size may be gained by the comparison made between it and the men of ordinary height standing by it, shown in the illustration from a photograph taken when the search light stood on the roof of the factory. It stands about 10 feet 6 inches high to the upper side of the ventilator on the top of the drum, and the total weight is about 6,000 lbs., but so perfectly is it mounted and balanced that a child can move it in any direction. See Figs. 1, 2 and 3.

The reflecting lens mirror used in this projector is 150 centimetres, or 60 inches, in diameter. It is a concave spherical mirror of the Mangin type, free from spherical aberration, reflecting a sensibly parallel beam of light. It was manufactured especially for this projector in Paris, France, and is a most perfect specimen of optical work, $8\frac{1}{4}$ inches thick at the edges and $\frac{1}{16}$ inch thick at the centre, and weighs about 800 lbs. The metal ring in which it is mounted weighs about 750 lbs., and the total lens, ring and cover weigh about 1,600 lbs. This great mirror is mounted at one end of the big drum, the outer end of which is furnished with a door consisting of a metal rim in which are fixed a number of plate glass strips $\frac{5}{16}$ inch thick by 6 inches wide. Inside this drum and sliding upon ways arranged on the bottom, is placed the electric lamp, the source of the light which is reflected by the mirror. It is entirely automatic in its action, is six feet high and weighs about 400 lbs. The carbons used are also made especially for it. The upper or positive carbon is $1\frac{1}{4}$ inch in diameter and $22\frac{1}{2}$ inches long, with a $\frac{5}{16}$ inch core of soft carbon running from end to end through its centre. The lower or negative carbon is $1\frac{1}{4}$ inch in diameter, is 15 inches long and also has a core of soft carbon running through its centre. In addition its outer surface is heavily coated with copper. The positive carbon is set a little in front of the negative and thus almost all the intense light of the incandescent crater is cast upon the reflector. The maximum current at which this lamp operates is 200 amperes, and at this current the lamp has a luminous intensity of about 90,000 to 100,000 candles,—the reflected beam a total luminous intensity of about 375,000,000 candles, an intensity which the eye cannot appreciate. Ventilators at the top and sides allow a constant current of air to pass through the drum and dissipate the heat generated by the arc lamp; and they are so arranged that no light can escape through them. All the connections for adjusting the positions of the carbons and the lamp are brought through the drum to the outside, and are arranged in close proximity to one another at one side so that all may be manipulated by the operator without moving from his position. Through openings in the drum covered by densely colored glass the operation of the lamp may be watched, and its adjustments verified. The drum is supported by trunnions in bearings at the top of a Y-shaped fork, set in a base plate, and the whole is supported on a system of friction wheels, forming a turntable resting upon the top of a massive pedestal supporting the whole structure. The drum, fork, and base plate may be rotated



FIGS. 2 AND 3.—THE HUGE SEARCH LIGHT OF THE GENERAL ELECTRIC CO.

horizontally on the turntable either by hand or by gearing provided for this purpose. The drum may also be elevated or depressed in a vertical plane by similar gearing.

How far the powerful beam of light of this instrument can be seen it is difficult to state. The search light set up by the General Electric Company on Mt. Washington in the White Mountains, has a diameter of only 30 inches, and a reflected light from the mirror of about 100,000 c. p., yet a newspaper can be read in its beam 10 miles away, and the light can be seen from points 100 miles distant.

NINTH ANNUAL MEETING OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

THE ninth annual meeting of the Association of Edison Illuminating Companies convened at the Wisconsin State Building at the World's Fair Grounds at 2 o'clock p. m., Tuesday, Aug. 8.

The following representatives were present: General Electric Company—S. Dana Greene, assistant general manager; F. P. Fish, legal department; A. E. Kennelly, consulting electrician Edison Laboratory; A. D. Page, F. E. Jackson, Wilson S. Howell, John W. Howell, lamp department; Chas. B. Davis, assistant manager, lighting department; W. J. Jenks, patent department; Albert B. Herrick, electrician Schenectady Works. Edison Electric Illuminating Company, of New York—James W. Pryor, secretary. Harrisburg (Pa.) Electric Company—John I. Beggs. Renovo Edison Light, Heat and Power Company—J. H. Sheddy, general manager. Edison Electric Light and Power Company, Little Rock, Ark.—G. H. Van Etten, president; J. A. Van Etten, manager; Leigh Carroll, stockholder. Edison Illuminating Company, Detroit, Mich.—C. P. Gilbert, secretary and manager; Hoyt Post, director and attorney. Edison Electric Illuminating Company, of Boston, Mass.—C. L. Edgar, general manager; J. Otis Wardwell, counsel and clerk; L. Stieringer, stockholder. Edison Light Co., Grand Rapids, Mich.—A. F. Walker, supt., Daniel McCoy, president; Appleton Edison Electric Co.—A. L. Smith, president; Scranton Illuminating, Heat and Power Co., Scranton, Pa.—Jas. P. Dickinson, vice-president, Fred. C. Hand, secretary; J. E. Parrish, supt. Edison Electric Light and Power Co., St. Paul, Minn.—Geo. H. Finn, secretary, treasurer and manager. Forest City Electric Light and Power Co., Rockford, Ill.—M. A. Beal, secretary, treasurer and director. Elgin City Railway Co., Elgin, Ill.—Chr. Wustenfeld, manager. Edison Electric Co., of New Orleans, La.—E. L. Bemiss, general manager. Columbus Light and Power Co., Columbus, O.—C. H. Lindenberg, director, A. W. Field, secretary and manager. Edison Electric Light and Power Co., of Kansas City, Mo.—E. R. Weeks, general manager. Des Moines Edison Light Co., of Des Moines, Ia.—J. A. Colby, general manager.

Reports were made by the following committees; Executive Committee; Admission of New Members; Committee on Lightning Protection, by A. E. Kennelly, chairman; Committee on Grounding the Neutral Wire; Committee on Prevention of Damage from Crosses with High Tension Circuits.

Addresses were made on the condition of the patent litigation and other matters concerning the relations of the illuminating companies and the General Electric Company by Messrs. S. D. GREENE and F. P. FISH Discussion on these subjects was participated in by a number of members.

By request of the Association, MR. LUTHER STIERINGER read a paper of great interest entitled: "Electrical Engineering at the Fair—What to see and how to see it."

CAPT. WILLIAM BROPHY, electrical inspector of the Industrial Mutual Insurance Company of Boston, was invited to address the Association on "Central Station Fire Insurance," and gave a detailed account of past fire losses in electric light and power stations and suggestions as to the prevention of such losses in future.

MR. F. E. BARKER, chairman of the Board of Gas and Electric Light Commissioners of Massachusetts was invited to explain to the Association the organization and the result of the work of the Board in the exercise of its extraordinary powers. His address was very clear and instructive and was followed by an animated discussion of the great desirability of securing such legislation as to introduce the same method of control in other states.

The Association having received an invitation to take a ride in the electric launches at 8 p. m. and a ride on the Ferris Wheel at 9.30, adjournment was made to 10 o'clock Wednesday.

The second session of the Association of Edison Illuminating Companies was held in the Wisconsin Building on the World's Fair Grounds on Wednesday, Aug. 9, at 10 o'clock a. m

MR. A. B. HERRICK read a very practical and important paper, illustrated by numerous diagrams, on "The Central Station Switchboard and its Adaptation to Different Modes of Distributing Potentials."

MR. A. E. KENNELLY of the Edison Laboratory read a paper which elaborates still further his very comprehensive paper first read before the Association at the Niagara Falls meeting in 1889 on "The Heating of Electrical Conductors," which has become a classic in electrical literature. The present paper is entitled "The Heating of Cables in Air, Water and Soil."

MR. C. E. CARPENTER was invited to exhibit and explain the peculiar construction of some patterns of rheostats which have recently been adopted by the General Electric Company. The discussion on this subject was unusually interesting, and was participated in by S. D. Greene, Capt. Brophy and others.

At the third session, commencing at 2 p. m., Mr. W. S. Barstow of Brooklyn, N. Y., submitted on a paper called: "Description and Test of the Third District Station of the Edison Electric Illuminating Company of Brooklyn."

The election of officers for the ensuing year resulted in the choice of the following gentlemen: C. L. Edgar, president; G. H. Finn, vice-president; W. S. Barstow, secretary; Wilson S. Howell, treasurer; John I. Beggs, chairman; F. P. Gilbert, E. R. Weeks, Wm. D. Marks, J. W. Pryor, C. L. Edgar, (*ex officio*), executive committee.

The retiring officers were thanked by vote of the Association.

The next meeting of the Association in August, 1894, will be held in Boston, the exact place of meeting to be announced by the executive committee.

The thanks of the Association were tendered to the Wisconsin State Commissioners for the use of the convention-room; to Mr. A. L. Smith of Appleton, Wis., for his personal interest and effort; to the Ferris Wheel Company, the Ice Road Company and the General Electric Company, for the entertainment afforded the delegates.

The secretary was instructed to prepare and incorporate in the minutes a résumé of the laws of Massachusetts creating the Board of Gas and Electric Light Commissioners and a statement of the work accomplished by them, as suggestive of favorable features applicable to other states.

The Association adjourned about 4 o'clock to meet in Boston on the second Tuesday in August of next year.

THE SEAGRAVE RAILWAY SIGNAL SYSTEM.

TESTS have recently been concluded on a section of the Pennsylvania Railroad, at Toledo, Ohio, on an electrical system of railway signals invented by Mr. Frank E. Seagrave, of Toledo. The system is very simple in its details, consisting essentially of a battery under the seat of the engineer in the cab of a locomotive, an alarm bell, electric switch, and press button for signaling, and a pole changer conveniently located, within reach of the engineer. Under the cab there is a wheel or brush for making contact with an insulated rail or conductor This insulated rail or conductor is laid in the centre of the track, in sections of one mile or more, and extends the whole length of the road. The poles of the battery are connected, one by contact wheel or brush with the central insulated conductor, and the other with the rail of the track by means of the wheels of the locomotive.

It is evident that anything that closes the circuit between the rail and central conductor, on this section of one mile or more, will ring the bell in the cab If a second locomotive, equipped like the one above, rolls on the same section, the bells in both cabs will sound the alarm, provided the polarities of the batteries on the engines are different. This alarm notifies each engineer of the proximity of another train, and the bells will continue to ring, so long as both locomotives are upon the same section. Either engineer can stop the ringing of the bell by throwing the electric switch, and can then open up communication with the other engineer, by means of the press button, using a code of signals. In this way, the necessary information and instruction can be conveyed to avoid collision.

Communication from a station to a moving train can be readily accomplished, by connecting the central conductor rail and one of the rails of the track to a press button in the office; then the circuit will be closed by pressing the button, and the bell in the cab will ring. provided a train is upon the section so connected. By extending a wire along the telegraph poles to an adjacent section, and connecting with the central insulated rail, communication can be accomplished with a train upon an adjacent section, and so on, to a distance of several miles in either direction, thus enabling the station agent to communicate with a train going in either direction, when at a distance of three or four miles.

To effect an alarm from an open switch or drawbridge, the central conductor and the rail of the track are connected with the standard of the switch, in such a manner that the circuit is closed when the arm of the switch is moved, and the rails are thrown out of alignment with the main track. If a locomotive now moves on to the section adjoining the switch or drawbridge, the alarm will sound in the cab.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

MISS MARGARET A. CLEAVES, secretary of the American Electro-Therapeutic Association, which is to hold its third annual meeting in Chicago, on September 12, 13 and 14, has issued a long list of papers and subjects to be brought forward at that time. A great many foreign physicians and specialists have been invited to contribute and participate.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JULY 25, 1893.

Alarms and Signals:—

Electric Signal for Fire Alarm Systems, Joseph Sachs, New York, N. Y., 502,207. Filed April 10, 1893.

Clocks:—

Self-winding and Synchronizing Clock, Arthur G. Wiseman, St. Louis, Mo., 502,156. Filed Oct. 28, 1892.
Employs one magnet for both the winding and synchronisation.

Electric Clock Synchronizer, Arthur G. Wiseman, Webster Groves, Mo., 502,157. Filed April 29, 1892.
Improvement on the invention patented to the same inventor May 12, 1891, No. 452,299.

Electric Winding Attachment for Clocks, Arthur G. Wiseman, St. Louis, Mo., 502,215. Filed July 30, 1892.

Conductors, Conduits and Insulators:—

Junction Box, Edward J. McEvoy, New York, N. Y., 502,062. Filed Jan. 3, 1893.
A moisture-proof box for systems of electric conductors.

Telephone Cable, W. R. Patterson, Chicago, Ill., 502,262. Filed July 30, 1892.
For the prevention of cross talk.
Claim follows:
The combination of two or more pairs of wires, the wires constituting the different pairs being twisted together with an undulating or varying degree of twisting, said strands being laid in the same cable to break joints with respect to the different undulations of twisting, whereby cross talk is prevented.

Dynamos and Motors:—

Commutator-Brush, Henry G. Reist, Lynn, Mass., 501,960. Filed March 15, 1893.
Composed of laminæ having transverse slits, with a view of increasing the resistance.

Means for Regulating Electric Motors, Charles H. Richardson, Philadelphia, Pa., 501,961. Filed January 16, 1893.
Employs generating coils upon the armature, in addition to the ordinary winding, for reducing speed and retaining torque. The operation is analogous to that of a fan blade regulator.

Electric Motor for Rotary Drilling-Machines, Robert M. Jones, Salt Lake City, Utah, 502,098. Filed Dec. 22, 1892.

Dynamo or Motor, Ralston C. Kintzing, Brooklyn, N. Y. Re-issue 11,354. Filed Jan. 25, 1893. Original No. 470,057, March 1, 1892.
Relates to details of design and construction. The form of both armature and field is spherical.

Electrolysis:—

Electrolytic Bath, Stephen H. Emmens, London, England, 501,996. Filed June 17, 1889.
Primarily designed for the production of malleable iron by electrolysis from ordinary pig iron.

Apparatus for the Electrolytic Extraction of Metals, Stephen H. Emmens, London, England, 501,997. Filed July 18, 1889.
For the production of malleable iron direct from the ore; also applicable to the reduction of copper ores and similar purposes.

Lamps and Appurtenances:—

Carbon Holder for Electric Arc Lamps, Sigmund Bergmann, New York, N. Y., 501,911. Filed Oct. 22, 1892.
Rack bar provided with a concave end holds convex-headed carbon holder.

Carbon Holder for Electric Arc Lamps, Frederic Dana Hazleton, New York, N. Y., 501,938. Filed Jan. 10, 1893.
A clamping device.

Illuminated Sign, Arthur L. McCormick, Port Huron, Mich., 502,007. Filed Feb. 17, 1893.

Electric Arc Lamp, Patrick J. Barrett, Boston, Mass., 502,166. Filed April 5, 1893.
Employs straight carbons converging below the lamp.

Measurement:—

Electric Measuring Instrument, Elihu Thomson, Swampscott, Mass., 502,022. Filed Feb. 17, 1893.
Claim 1 follows:
An electric measuring instrument composed of a single balanced horseshoe magnet with its poles closely approximated and a plate interposed between the poles of the magnet, the plate conducting the current to be measured at an approximate right angle to the field of the magnet.

Electrical Measuring Instrument, Rudolph M. Hunter, Philadelphia, Pa., 502,077. Filed March 23, 1893.
Employs expansible bodies, one to be expanded positively by the current to be measured, and the other to expand only under atmospheric changes of temperature for compensation.

Miscellaneous:—

Pipe Coupling, Rheinhold Herman, Crafton, Pa., 502,038. Filed May 2, 1893.
For combined gas and electric light fixtures.

Rheostat, Chas. A. Hussey, New York, N. Y., 502,040. Filed May 23, 1892.
Applicable to varying the illuminating power of an electric lamp.

Musical Instrument, Konstantin Polenoff, Nishue Taguilsk, Russia, 502,103. Filed Sept. 7, 1891.
An electromagnetic device for an automatic keyed instrument.

Electric Switching Apparatus, Arthur R. Roe, Duluth, Minn., 502,104. Filed Sept. 24, 1892.
A rheostatic switch.

Electric Switching Apparatus, Arthur Richard Roe, Duluth, Minn., 502,105. Filed Oct. 28, 1892.
For operating any one of a number of combinations of electric switches and rheostats simultaneously.

Combined Phonograph and Coin-Operated Mechanism, W. S. Burnett, Milwaukee, Wis., 502,246. Filed Aug. 18, 1890.
Employs an electric motor.

Railways and Appliances:—

Electric Railway Trolley, Elmer A. Sperry, Chicago, Ill., 501,968. Filed April 1, 1893.

Electric Locomotive, Elmer A. Sperry, Chicago, Ill., 502,090. Filed Oct. 28, 1891.
Relates to construction and mounting of the armature and journal and to the field magnets and supporting frame.

Trolley Wire and Hanger, Earl P. Wetmore, Helena, Mont., 502,088. Filed Dec. 28, 1892.

Conduit System for Electric Railways, Frank Wynne, London, England, 502,216. Filed April 3, 1891.
A sectional conductor system.

Connection for Track Circuits, E. H. Goodman, Pittsburgh, Pa., 502,220. Filed Nov. 1, 1892.
Adapted to railway signaling systems.

Electric Railway Trolley, C. J. Van Depoele, Lynn, Mass., (Deceased), A. Wahl and C. A. Coffin, Executors, 502,243. Filed Aug. 9, 1888.
Claim 1 follows:
In electric railways a car provided with a contact carrying arm having a contact device at its free extremity and mounted at its lower end on a transverse axis carried by a support located upon the top of the car.

Telephones and Apparatus:—

System of Telephonic Intercommunication, Frank R. Colvin, New York, N. Y., 502,091. Filed Oct. 15, 1892.
For intercommunication between a number of stations, in which each station may at will communicate directly with any of the other stations, or with any one of a certain predetermined number less than the whole number of stations. The system precludes the interception or overhearing of conversation by persons at other stations than those in correspondence.

LITERATURE.

Patentable Invention. By Edward S. Renwick, C. E. and M. E. *Rochester, N. Y.*, The Lawyers' Co-operative Publishing Co. Law Sheep, 12mo, 156 pp. Price $2.00.

"MANY works upon the Law of Patents for Inventions have been published, but they have been written by jurists who have not been mechanics or inventors, and have not been familiar with the working of an inventor's mind," says the author of Patentable Invention in his preface. This might be taken to imply that he has a poor opinion of the working of a lawyer's mind on the subject of patentable inventions; but that inference is hardly justified. Patent law has been called the metaphysics of jurisprudence. Mr. Renwick would eliminate the metaphysical altogether. His book is mainly a polemic against a tendency which he discerns on the part of the courts to give much consideration to the metaphysical inquiry whether in any given case a patentee has produced an "invention" or merely exhibited skilfulness. At the outset he quotes the following dictum pronounced by the United States Supreme Court in 1880 (Pearce *v.* Mulford):

"But all improvement is not invention and entitled to protection as such. Thus to entitle it, it must be the product of some exercise of the inventive faculties."

"What these faculties are," says the author, "or how they are to be distinguished from the constructive faculty of the mind, is a matter that is left by the court in profound obscurity." The contention of the book is that it is practically impossible to determine the existence of invention under the doctrine of the above dictum; because no two persons will draw the same line of separation between the two faculties, one finding the so-called inventive faculty exhibited in changes that appear to another due only to constructive faculty or mechanical skill, and no fixed rules are obtainable under which just conclusions can be reached. But the validity of patents ought to be determined under fixed rules and upon evidence; otherwise all is mere matter of opinion. Diverse constructions of the law of patents under what may be called the psychological method of investigation are regarded by Mr. Renwick as especially unfortunate in view of the recent establishment of nine appellate courts as likely to lead, in the absence of common rules, to a clashing of decisions one with another. The effects produced by an alleged invention, their novelty and utility, are matters of evidence, to which rules can be applied, and they should be resorted to in determining patentability rather than an inquiry into the mental processes of the inventor.

Mr. Renwick has drawn upon his reading and his large experience as a solicitor of patents and as an expert in patent causes to furnish many interesting and suggestive illustrations throughout his book.

The tendency of his ideas, if fully adopted by the Patent Office and by the courts, would doubtless lead to greater liberality to inventors in the granting and sustaining of patents. Most persons having anything to do with patents would probably deplore any increase in the facility of granting them on the part of the Patent Office. The practice of the office of late seems to have been based upon extreme liberality to inventors in finding novelty and utility in their applications, and in ignoring the distinction between "invention" and mechanical, constructive or engineering skill.

"CALCULATING BOYS" AND PUZZLED HUMORISTS.

A RECENT issue of THE ELECTRICAL ENGINEER, of New York, contains a Paper and a short note on "Calculating Armatures." The title puzzled us at first, as our thoughts were carried to phenomenal "calculating boys;" but we find that this is not an announcement of a new prodigy, but merely a new method for getting out armature quantities. The method "is based on the analogy between the torque at the periphery of the armature and the pressure on the piston of a steam engine." If occult analogies can ever evolve good armature proportions, this one may do as well as another. In a similar manner we might design a flap-valve from its analogy with a five-barred gate, or an arc lamp from its analogy with the rush-light.—*London Punch.*

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

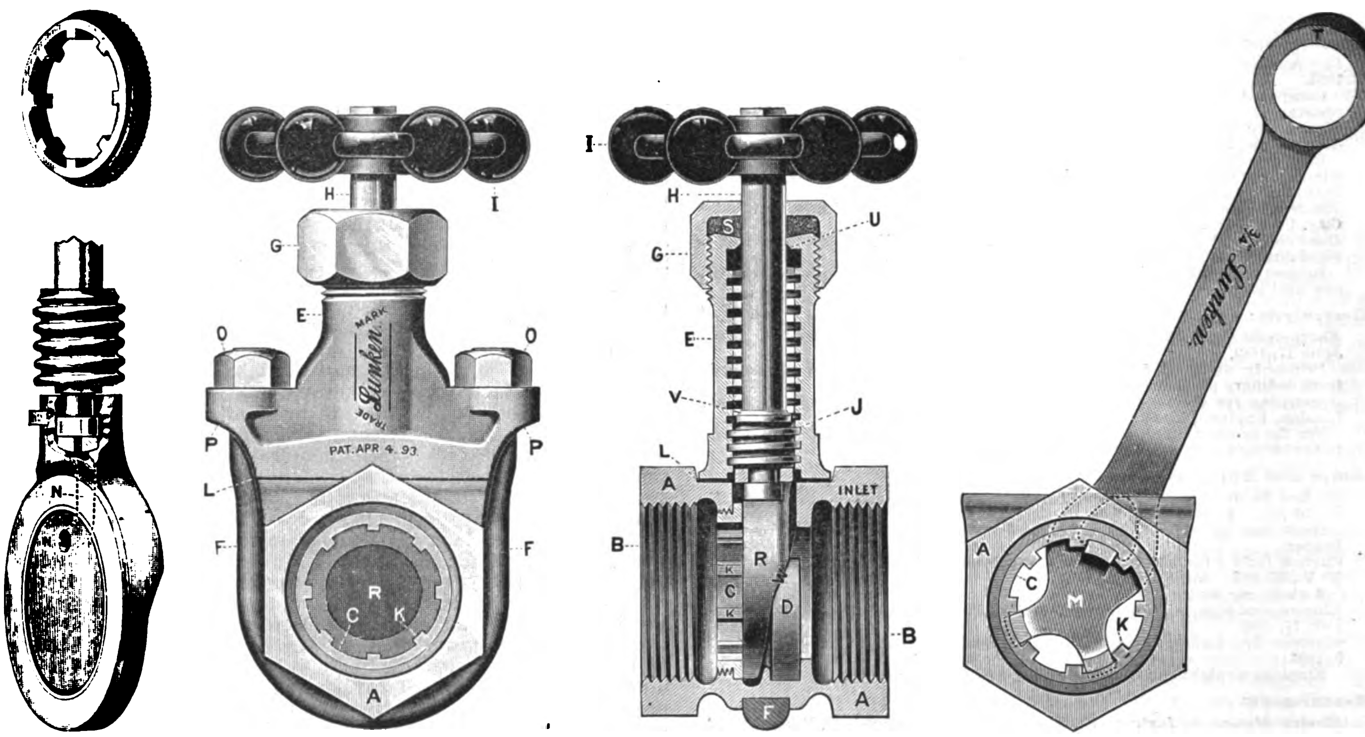
THE NEW "LUNKEN" GATE VALVE.

It is well known by all intelligent steam users, that the ordinary globe valve, on account of its crooked and cramped passage, is a very imperfect valve, causing a loss through resistance that is enormous. Users of valves are beginning to realize this fact, which accounts for the increased use of straightway or gate valves. There is to-day not a valve in the market (either globe or gate) in which the seat is practically renewable, which fact necessitates the renewal of the complete valve, in case the seat becomes cut or much worn.

Realizing these facts, the Lunkenheimer Company of Cincinnati, O., whose many specialties are renowned, will shortly add to their popular specialties the "Lunken" gate valve, which will excite much interest among valve users, as it possesses several important improvements over valves now used. It is an almost complete departure from the usual pattern, being more simple, compact and durable than even a common globe valve, although possessing the advantage of being a straightway valve. To get liquid on the back or wedge side of disc also aids to make a tight-closing valve.

All valves above 2¼ inches in size are provided with a "by-pass," which arrangement balances the disc before opening it, and thus reduces the friction and wear on seat and disc to a minimum, and makes the valve open easily, regardless of what heavy pressure may be on same. This automatic by-pass attachment is a most important improvement and, it is claimed, makes the "Lunken" gate valve the only really practical straightway steam and high pressure valve thus far constructed. The by-pass is an auxiliary valve formed in the top of the valve-disc and is operated by the stem of the valve, automatically, while opening or closing the main valve.

The renewable seat, it will be seen by referring to the cuts, is an exteriorly threaded flanged ring that screws against a face or shoulder of the flange, the opposite side of which flange forms the seat or bearing surface for the disc to close against. The inner periphery of the ring has lugs or teeth K for the engagement of a wrench M by which means, after taking off the bonnet E, the seat is operated, and either taken out or put in through the disc-opening of the body, without disturbing the pipe connections. In iron body valves the renewable seat C screws into a second brass ring permanently fastened in the iron shell; otherwise, owing to the rusting qualities of iron, the renewable seat might rust tight in the shell. The ring end T of the wrench is used to hold and guide the



The New "Lunken" Gate Valve.

an idea of the compactness of this valve, it is worthy of mention that a one-inch valve (warranted to stand fully 150 pounds working pressure) weighs ¾ pound less than the lightest one-inch common globe valve in the market.

Referring to the illustrations, it will be seen that the valve is unique and very neat in appearance, and of a construction that would indicate great strength. The hub or bonnet is held to the shell by a coppered steel clip or strap surrounding the shell with its ends passing through the ears of the bonnet and secured by nuts O. This clip is held from lateral movement by projections on the shell. The joint is packed by a hard lead washer of $\frac{1}{16}$ inch thickness, the top faces or flanges each having a groove to properly secure the washer. The valve can easily be taken apart without renewing the packing washer. The hub or bonnet is flat and narrow, and just of sufficient size to receive within it the valve disk when entirely raised, and has sectional or part-nut threads in its opposite interior sides. The threaded portion J of the stem by engaging with these part threads, causes the valve to be opened or closed. The disc has a straight flat face or bearing against the renewable seat C and is forced tightly against the same by the self-adjusting wedging half-ring or horseshoe D secured loosely in the valve shell. The wedging on the disc is applied on two wedging surfaces, diametrically opposite each other, these coming in contact with the beveled ends of the half-ring or horseshoe wedge; thus the wedging is properly equalized on the entire disc and insures a tight joint on the opposite face. The pressure of the steam or removable seat into place, so as to properly start its threads into the threads in the shell.

As regards outside finish, the shape and construction are such as to necessitate only the finishing of the stuffing-box, the remainder being left a smooth casting, while the steel band and nuts are drop forged and nicely copperplated to prevent rust.

This ingenious and simple valve is the invention of Mr. Edm. H. Lunken, whose reputation as an inventor is already established, being the inventor of all the celebrated specialties manufactured by The Lunkenheimer Company of Cincinnati, Ohio. The Lunkenheimer Company of Cincinnati, after having experimented with and tested valves for the past six months on pressures exceeding 150 lbs., are now busily at work getting out valves in brass from ¼ inch to three inches and iron with screwed ends from two inches to 12 inches, and expect in a few weeks to be ready to take orders. This company have a large exhibit at the Chicago World's Fair in Machinery Hall, Section 25, Column 0-24, with a complete display of their specialties, where visitors can also see samples of the "Lunken" gate valve.

C. S. Knowles, 5 and 7 Arch street, Boston, has issued a handsome and elaborate catalogue, No. 2, of his material and specialties for electrical purposes. Every page bears his familiar autograph. He is now represented in New York by Mr. A. T. Bell, who has his headquarters at 148 Liberty street. The Chicago office is in the Adams Express Building.

THE CENTRAL ELECTRIC HEATING COMPANY.

CATALOGUE No. 1 has just been issued by the Central Electric Heating Co., of its apparatus made under the patents of the American Electric Heating Corporation, which for some time past has been securing control of the fundamental inventions in this new and highly important field. The catalogue, besides being a neat and pretty publication is most interesting, and it may safely be said that no electrical trade pamphlet of the whole year has been more worthy of attention on the part of the electrical community and of the public at large. There is a brief and pithy introduction on the subject of electric heating, which is followed up by a most attractive and suggestive display of electric heating and cooking apparatus of all shapes, kinds and sizes. The evolution of the ordinary radiator, the familiar stove, the "common or garden" gluepot, the everyday flatiron, the bachelor's broiler, the family teapot, and the restaurant hot water reservoir is, really, very curious, and one can see at a glance that a vast amount of ingenuity and shrewdness has been devoted to the practical utilization of electricity in all that pertains to heating and cooking. Not only is the domestic branch of work fully covered, but the catalogue includes a vast variety of apparatus for offices, steamships, cigar stores, metal working shops, hat factories, etc. We earnestly recommend this catalogue to the attention of all local companies, or operators of isolated plants, believing they will find it worth while to make an early trial of some one or other of these specialties. The company will be glad to respond to any inquiries, and correspondence can be greatly facilitated if at the outset the voltage is stated and the nature of the current named, whether direct or alternating. The welcome day of electric heating is begun, and this catalogue is one of its most noteworthy heralds.

THE "IDEAL" ENGINES.

WE are in receipt of the new catalogue of the Ideal engines, built by Messrs. A. L. Ide & Son, of Springfield, Ill., and from them we gain much interesting information regarding the latest construction of these well-known engines. The general design of the single expansion "Ideal" is illustrated in the engraving, Fig. 1, and it comes under the head of the high speed class. In order to make the operation of the engine practicable for long continuous runs special attention has been given to lubrication. It will be noticed that the crank disc is fitted with a light, oil-tight hood, but which is not fastened with bolts and which can, therefore, be readily removed; the cross-head and side guides are likewise enclosed, but easily accessible by the removal of a side plate. In this manner no oil can be thrown on belts or floor. The crank disc dips only about one inch into the oil, and none of the parts are submerged. The motion of the disc delivers it into a pocket extending across the inside of the hood and through a pipe attached to the outside of the hood into the oil pocket, through which the oil is carried down in streams to the crank shaft bearings, and thence back to an oil chamber under the crank disc. Special provisions are also made for oiling the crank and the cross-head pins.

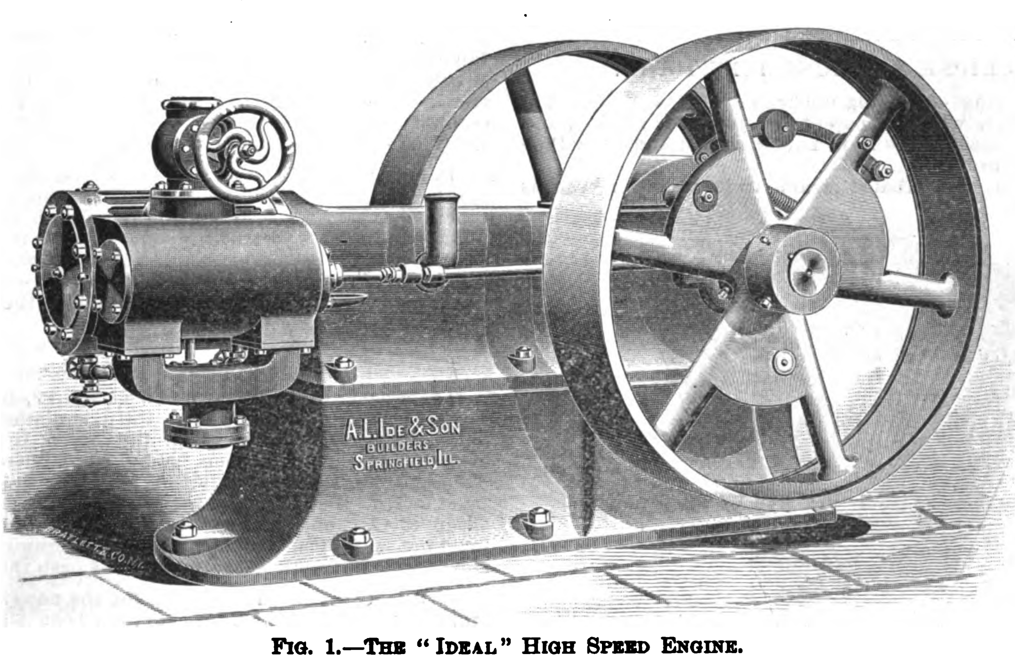


FIG. 1.—THE "IDEAL" HIGH SPEED ENGINE.

The steam distribution has been worked out with special care. The valve, which is shown in Fig. 2, is of the hollow piston type,—a hollow cylinder with a piston at each end. The live steam is entirely upon the outside of this piston pressing equally on each end, and the exhaust steam is entirely on the inside of the piston, so the valve is perfectly balanced and can easily be moved by hand when under full boiler pressure.

Operating at high speeds it is specially desirable to have a quick acting, sensitive governor and this has been provided in the Ideal engine so that the difference in speed between full load and no load does not exceed one per cent. Besides the single expansion engines, the company also manufacture tandem compound engines, designed with the same care as the former and which have met with marked success in electric light and railway power stations.

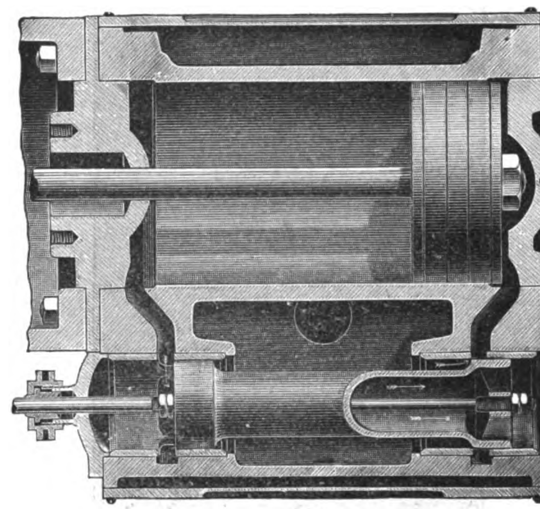


FIG. 2.—VALVE OF IDEAL ENGINE.

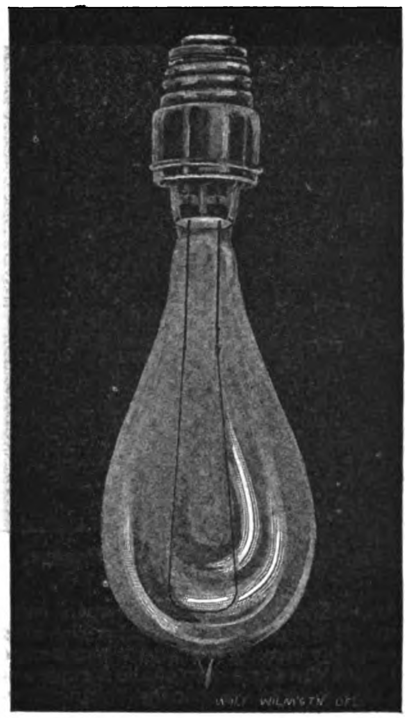
THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY have now removed their entire stock and business to Minneapolis, and are located at No. 249 Second avenue South, where they occupy four floors and basement of the Lincoln Block, which is being rapidly filled from top to bottom with the largest and best selected stock of electrical supplies in the Northwest. The following are some of the specialties handled by them in the Northwest: National incandescent apparatus, Standard arc apparatus, Eddy motors, Holtzer-Cabot motors, Paranite rubber covered wire, Grimshaw White Core, "O. K." weatherproof, Holmes, Booth & Hayden's Underwriters', Syracuse sockets, cut-outs and switches, and Packard lamps.

Since moving to Minneapolis the above company have for convenience shortened their name, and are now known as the "Electrical Engineering Company."

THE NON-INFRINGING LAMP OF THE PENNSYLVANIA ELECTRICAL ENGINEERING CO.

The accompanying illustration shows the new incandescent lamp now being manufactured by the Pennsylvania Electrical



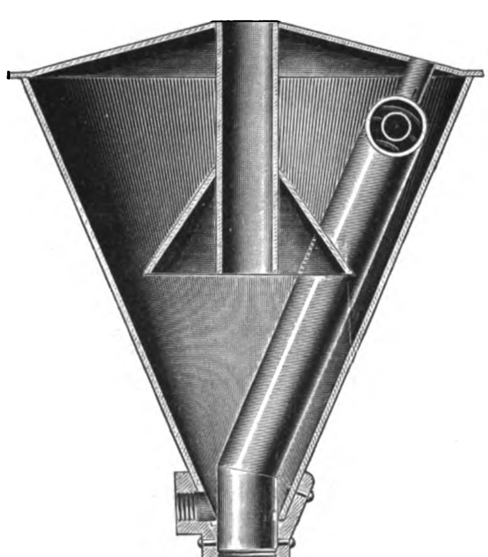
Another Non-Infringing Lamp.

Engineering Company, Penn Mutual Building, Philadelphia. This lamp differs from that heretofore manufactured by this company in that the "receiver" is not made entirely of glass, and hence does not come under the claims of the Edison lamp patent.

THE ECLIPSE EXHAUST PIPE HEAD.

The accompanying engraving illustrates the new Eclipse Exhaust pipe head, on which a patent has just been granted and which is manufactured by the New York Exhaust and Blow Pipe Company, at Hartford, Conn.

As will be seen, the exhaust steam, as it enters the head, is



The Eclipse Exhaust Pipe Head.

carried near the top, then discharged horizontally around the head, giving it a centrifugal motion, and driving all the solid matter to the outer wall, there to run down the side, and out to the drip, and allowing the light and dry steam to escape through the centre of the top. In addition to the above centrifugal motion for separating the heavy matter from the light, there is a small pipe running from the top outside, and so connected, that when the exhaust steam is passing through the large pipe, it causes a suction in the smaller one, thereby drawing cold air into the head, which, combined with the centrifugal motion, makes a very efficient system of condensing steam.

These exhaust heads are meeting with great success and the company expect a prosperous future with them. The New York office of the company is at No. 136 Liberty street.

NEW YORK NOTES.

The Ferracute Machine Company, of Bridgeton, N. J., have a large exhibit of their presses, spinning lathes, and other sheet-metal machinery as well as a number of dies, at the Columbian Exposition. They are located in the centre of Machinery Hall Annex, Columns I, J, 42. Their space is about 30 feet square and they have a small auxiliary space on the centre aisle also. They have at their space two large drawing presses, a large double crank press, three of their new style of C presses, particularly adapted for electrical work, two punching presses and a number of foot, screw and drop presses, two spinning lathes, beaders, threaders, crimpers, etc., in operation daily. They are manufacturing a number of small goods in aluminum, brass and tin which illustrate the work done in their presses. All of these presses are from new designs and have a number of improvements in the way of new clutches and adjustments, convenient clamping arrangement for setting dies, etc. Their exhibit is driven from a line of shafting of their own, and an upright engine gives them their motive power. They have a new office fitted up in connection with their space and will be glad to welcome any one in the metal working trades at any time.

Mr. Hoffman, foreman of the press department, is in charge of their exhibit, and Mr. Stevenson in charge of the dies, running presses and manufacturing the sheet-metal goods. There are a number of dies in operation which are of special interest to the sheet-metal trade in the manufacture of cups, plates, pans and small fancy goods. They also show one of their embossing presses and one of their coining presses, which are adapted for medals, badges and fancy work of various kinds. They also show on their wall space a great variety of articles in sheet metals which have been manufactured in their presses and dies. Their whole exhibit is a very interesting one.

They are about to issue a new catalogue describing their new lines of presses.

D. S. Holcomb, of 48 Dey street, New York, reports the following sales for last week: A 3 h. p. C. & C. motor to F. V. Doane, University place and Thirteenth street, and five Meston fan motors to Mr. O'Connor for his new saloon, Cedar and West streets. This young enterprising electric expert is very busy re-winding armatures and with many orders on hand. He has secured the valuable services of Mr. Joseph Duryea, who until lately was representing the General Electric through the South.

In our "Want" columns will be found the advertisement of a gentleman, signed "General Manager," who has had eight years' practical experience in the operation of electric light and railway plants, and who is thoroughly versed in all that pertains to their management. From personal knowledge we can speak in the highest terms of the advertiser's knowledge and ability and can recommend him to any company desiring the services of a competent manager.

WESTERN NOTES.

The Electrical Engineering Company, Minneapolis, Minn., report having just completed the installation of a 2,500-light alternator and transformers for the City of Brainerd, Minn., and are at present installing one 800-light incandescent machine, two 50-light Standard arc machines, and two 40-light Standard arc machines, in the new department store being completed for S. E. Olson & Co., of Minneapolis. Current from the incandescent machine will also be furnished for running two passenger elevators, one freight elevator, and the cash railway system.

The Brush Lighting Plant for the newly built Illinois Central station at Park Row, Chicago, has been started. The equipment includes two 100 kilowatt and one 50 kilowatt generators with a total capacity of 5,000 lights.

The Buckeye Iron and Brass Works, of Dayton, O., have issued a pretty little folder inviting their friends to call on them in section 28, column K, 44 and 45 Machinery Annex, World's Fair.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVI. AUGUST 23, 1893. No. 277.

THE "NEW BEACON" NON-INFRINGING INCANDESCENT LAMP.

I.

ELECTRIC lighting as an art and as a branch of trade has seen some remarkable developments during 1893, and it may well be doubted whether any year since the dawn of incandescent lighting has been fuller of events of vital interest and importance. The beginning of the year witnessed the dramatic unfolding of the story of Henry Goebel, put forward as a defence by the Beacon Vacuum Pump and Electrical Company, of Boston; and the varying fortunes of that defence, in the courts, have been even more startling than the original effect of its production "at the eleventh hour" and fifty-ninth minute. Concurrent with the fluctuations of hope and belief in the sufficiency of the Goebel story, have gone on elaborate experiments in the perfection of forms of incandescent lamps differing from the Edison, and in this field greater inventive activity has been seen during the past six months than in any other. In some directions, the effort seems to have been directed to the evasion of the Edison patent, while in others an effort has been made to produce a *new* lamp that would stand for itself, free from litigious assault and salable whether the Edison patent were broken or not. Naturally the Beacon Company, which first stemmed the tide of monopoly, was first also to investigate the possibilities of the field outside familiar forms of incandescent lamp; and its reappearance in the market with a new lamp has been awaited with no little curiosity on the part of all who have to deal with the subject. We are glad now to be able to say something about the new Beacon lamp, supplemented by a few words about its inventors.

II.

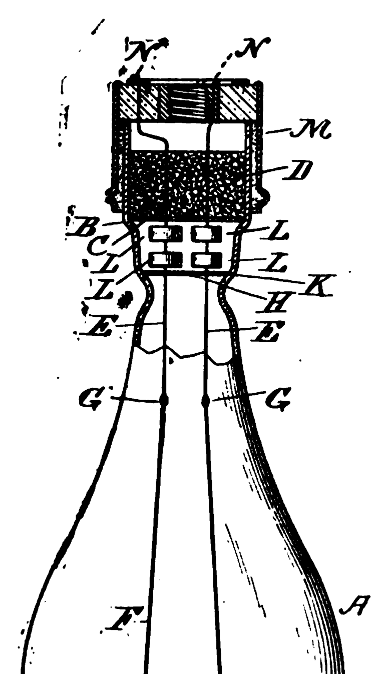
The Beacon Vacuum Pump and Electrical Company are now offering a new lamp which they claim is first-class and does not infringe any patent whatsoever. The enclosing globe is not made entirely of glass inasmuch as no glass is used in closing the neck of the lamps nor do the leading-in wires pass through the glass. On the contrary the neck of the lamp is closed with a peculiar fusible cement, which is of a nature entirely distinct from glass. The only substance other than cement, used in closing the lamp neck, is a supporting disc of mica.

The lamps are proving satisfactory and the company anticipate doing a large business in the near future. They claim that the new lamp is not devised merely for the purpose of evading existing patents, but has such merits of its own, that they would not now make the old type of lamp, were they free to do so. No platinum is used in the construction of the lamp, and it is said to be cheaper to manufacture than the old style. They believe they have the only practicable lamp against which the charge of infringement cannot reasonably be brought in view of the decisions of the courts up to date.

The lamp which has been christened the "New Beacon" is neat in appearance and bids fair to become a leader among its kind.

This "New Beacon" lamp is the invention of Wm. E. Nickerson and Edw. E. Cary, the former the mechanical and chemical expert, and the latter the electrical expert, of the Beacon Company. The company have acquired from the inventors the control of the patent rights, which are said to be very comprehensive.

The Beacon Company have signified their willingness to license other manufacturers to make their new and improved lamp, on a basis which will enable them to manufacture them, royalty added, at a less cost than they can make the lamps of the Edison type, at the same time



THE "NEW BEACON" NON-INFRINGING INCANDESCENT LAMP.

assuring manufacturers that their output would be greater for the same plant.

III.

The diagram shows the general construction of the "New Beacon" lamp. The glass globe of the lamp A is provided with a shoulder at B, upon which rests a thin disc of mica C. The disc serves as a support for a body of cement, the composition of which is not disclosed, which is poured, in a fused state, upon it, and completely fills the upper part of the neck of the lamp. This cement is of a novel composition and is not only absolutely impervious to

air itself, but makes an equally airtight union or joint with the glass surface of the lamp neck. It is able to withstand the temperature to which it is subjected in the operating lamp without leaking or giving off any gases or vapor whatsoever. It achieves results which although often sought have never before, it is said, been accomplished. The leading-in wires E E, which are of iron throughout, pass through this cement and through the mica disc C, but nowhere touching the glass of the enclosing globe, and are connected with the filament or burner F, at G G. A second disc of mica H, is located within the neck of the lamp globe and rests upon the shoulder K. The disc H acts as a reflector and throws back the heat of the filament, thereby keeping the cement plug from being affected.

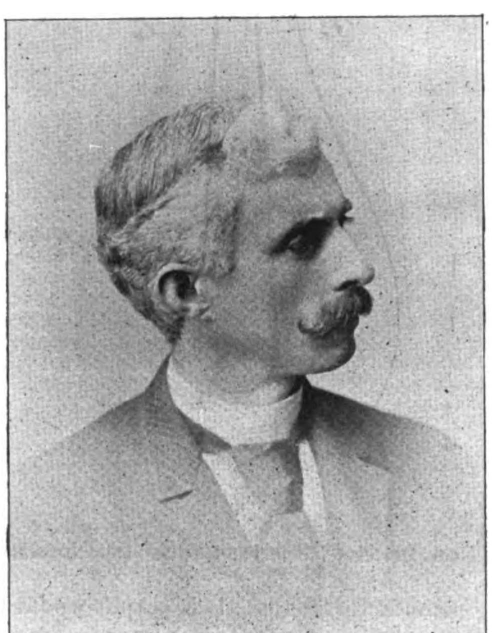
Upon the leading-in wires between the two mica discs are placed small bodies of metal L L L L, called radiators. They are so called because they take up the heat of the leading-in wires and disperse it by radiation, preventing it from being carried into the cement plug. They are a very neat and effective device for the purpose which they accomplish.

The lamp neck is surmounted by a cap or base M, of the ordinary kind, fastened in place by plaster of Paris, and to which the leading-in wires are attached by soldering at N N.

While the lamp is burning, the cap and socket are nearly as cool as when it is not in operation, a phenomenon not known in other lamps, and the candle power holds up in the same remarkable manner as it did in the old "Beacon" lamp.

The new lamp cannot be excelled the makers say, for cheapness of manufacture, and with the qualities claimed for it, cannot fail to become a popular favorite.

The inventors as well as the Beacon Company are proud of their achievement and believe that they have very nearly attained perfection, in the development of an economical and efficient lamp of the modern incandescent type.



William Emery Nickerson.

It is worthy of note that these "New Beacon" lamps have already been shipped out in large quantities, over 50,000 of them being already in actual service. Mr. Kaliske, the manager of the company, informs us that they are in daily receipt of very large orders, and that the lamps have given the utmost satisfaction. As numbers of the lamps have been in operation for two or three months, it is also gratifying to note that the company have made no public claims for their excellence until they had received a thorough test, and had perfect assurance of their success.

IV.

A few words may now with all propriety be added with regard to the two inventors who have been developing

Edward E. Cary.

this lamp with an enthusiasm of the warmest kind. The improvement of incandescent lamps is no easy thing, and the evolution of new types is much more difficult than the uninformed imagine. We have heard it said that no lamp manufacturer can excel in more than one voltage of lamps, but while that is a humorous exaggeration it does suggest a task which in reality is far beyond the common.

William Emery Nickerson is of old New England stock and was born in Provincetown, Mass., Nov. 5, 1853. He graduated from the High School of that place. He graduated from the Massachusetts Institute of Technology in 1876, in the department of Chemistry. He was for several years instructor in the chemical laboratory of that Institution, and private assistant to Prof. Nichols, now deceased, for whom he did a large amount of work on analysis of water from many parts of Massachusetts and of air from schools, prisons and railway trains, in the interest of the State Board of Health.

In the years 1877–80, he gained a reputation among the leather manufacturers having headquarters in Boston, as an expert in matters relating to the leaching of tan bark, the estimation of tannic acid, and other matters appertaining to leather manufacture from a scientific point of view. For some time he practiced as an analytical and consulting chemist, and spent a number of years in mining in the gold belt of Northern Georgia. Although educated as a chemist, he has had a large experience in applied mechanics, having designed and built an extended variety of machines and mechanical appliances.

He has given a great deal of attention to inventions and improvements and his name appears upwards of a hundred times in the list of American patents. He has also familiarized himself with the practice before the Patent Office, and always writes his own patent specifications, as well as many for inventive friends, and is said to be usually success-

ful in drawing specifications and claims which thoroughly define and cover the invention.

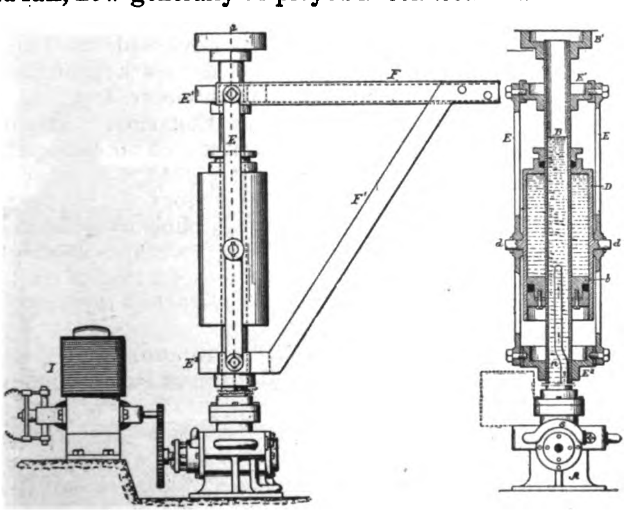
He discovered the principles on which the non-mercurial vacuum pump of the Beacon Company operates, and is the perfector and chief inventor of that now famous machine. The Beacon Company looks principally to him for the solution of its mechanical and chemical problems. He does not claim to be an electrician, although he is by no means ignorant of electrical matters. He is an inventor by nature and finds it impossible to keep his mind from being engaged in trying to produce something new and better in the industrial arts; and an opportunity such as that presented by the lamp situation made an irresistible appeal to him.

Edward E. Cary, his associate in the invention, was born in Albany, N. Y., February, 1866. His early life was passed in New York City and Brooklyn. He graduated from the Brooklyn Polytechnic Institute in 1884, and was in the years 1883–5 private assistant to Prof. Robert Spice of Brooklyn. Three years were then passed as assistant in the Newark laboratory of Edward Weston. In 1888 he entered the employ of the Westinghouse Company and remained in the Pittsburgh lamp factory three years. June, 1891, found him engaged on special filament work in the Twenty-third street factory of the Westinghouse Company in New York City. At this time he saw an opportunity for future advancement with the Beacon Company in Boston, and accepting an offer from them took charge of the lamp manufacturing department of their business, which position he still holds.

Mr. Cary, although young, is rich in experience in the art of incandescent lamp making. His natural talent, thorough education and large experience have made him a master of this art. The high standard of excellence attained by the "Beacon" lamp was due in no small degree to the perfection of the work in his department. The fact that the "New Beacon" lamp will be provided with filaments made under his direction and will be exhausted on the patented pumps of the company ought to be taken as a sufficient guarantee that it will lead as the "Beacon" lamp did before it.

THE ATWOOD ELECTRO-HYDRAULIC CRANE.

In order to avoid the use of winding drums and block and fall, now generally employed in connection with cranes,



FIGS. 1 AND 2.—THE ATWOOD ELECTRIC CRANE.

Mr. L. Atwood, of the Stokes & Parrish Elevator Company, of Philadelphia, has designed the arrangement shown in the accompanying engravings. The design here embodied consists of an arrangement by which the arm of the crane with its load is lifted bodily by the action of a hydraulic plunger. The hydraulic pressure required is obtained by the use of an electric motor which drives a pump.

The engraving, Fig. 2, shows the pump and hydraulic arrangement in section. Secured to the standard B is a piston *b* and fitting over the piston and the st ndard is a movable cylinder D open at its lower end and packed at its upper end to prevent the escape of fluid between the cylinder and the standard. On the exterior of the cylinder are pins *d d* on which are mounted the tie bars E E secured at their upper and lower ends, respectively, to collars E^1 E^2 which slide on the standard B above and below the cylinder. The crane arm F is secured to the collar E^1. The object of the construction just described is to prevent the binding of the cylinder upon the standard when the load is being raised. The manipulation and regulation of the crane is effected by means of a valve, which controls the fluid in the cylinder; the motor can thus be kept in continuous rotation, and a self-regulating shunt machine employed. In this manner all regulating devices, rheostats and switches are done away with, a single valve lever being all that is necessary to manipulate the load.

ANOTHER AMBITIOUS TRANSMISSION FOR CALIFORNIA.

THE scheme for constructing a canal in the interior of California parallel to the coast is a most ambitious one. The cost is put at $10,000,000. The originator hopes to see steamers going up from tidewater to Bakersfield, 290 miles distant, in the near future. "The main canal," he says, "will be 175 miles long, from Suisun Bay to Tulare Lake. It will be extended to Bakersfield, and there will be branch canals running out to various important towns. It will be large enough to carry vessels of heavy draught, and will be just what its name implies—a ship canal. A system of immense locks will be necessary, and thereby we will obtain another great value from the canal. The surplus water in the locks will be distributed through the lower adjoining country for irrigation, and the elevation at each lock will give great facilities for water power. Motors operated by the water would furnish electric lights for all the towns on our line. From Suisun Bay the canal will extend down the San Joaquin Valley, the river being utilized most of the way. Tulare, Buena Vista and Kern Lakes and the Kern River will be included in the route, and they will save a great deal of work in the construction. The water will be obtained from these lakes and rivers and from the natural drainage. The drainage is an important factor and we will annually save whole lakes of water that is now lost. The water that flows down from one section of the canal will be saved in the lower locks. It will be a large volume of water, for the canal will be at least 50 feet wide in its general portion and the locks will be huge reservoirs." The canal is by no means a "fixture" yet; the projector has to raise the money for constructing it.

GOVERNMENT TELEGRAPH TOLLS.

POSTMASTER-GENERAL BISSELL has issued an order fixing the rate to be paid telegraph companies for transmitting all government messages (not including those passing over circuits established by the weather bureau) during the year ending June 30, 1894. The fixed rates are:

For day messages, containing not more than twenty words. exclusive of place from and date, 20 cents, not exceeding 1,000 miles, and one cent for each additional word. One-quarter of this rate to be added for each 500 miles or fraction thereof, but no rate on a message of twenty words to be more than 40 cents, nor on an additional word more than two cents.

The rate between any points in any state or territory or the District of Columbia shall be twenty cents for twenty words and one cent for each additional word. For night messages not exceeding twenty words, exclusive of place from and date, fifteen cents for any distance within 2,000 miles, and for greater distances twenty-five cents; in each case one cent for each additional word.

It is further provided that if during the year any telegraph company charges the public less for ten words than is here fixed for twenty words, the government rate shall be reduced to the rate charged the public.

These rates are somewhat in excess of those fixed by Postmaster-General Wanamaker, which were not accepted by the telegraph companies, but are materially less than those fixed by Postmaster-General Dickinson in 1888.

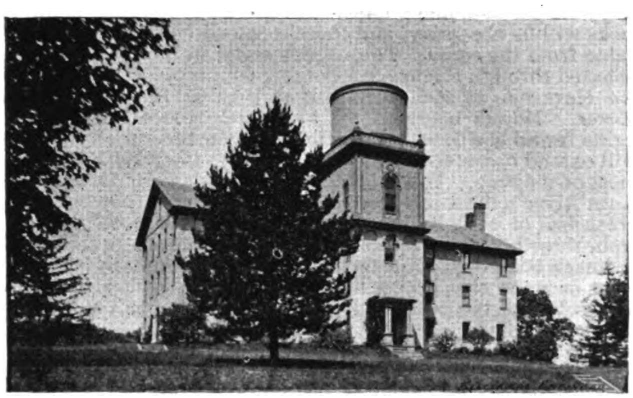
THE HYPNOTIZING TROLLEY.

The opponents of the "deadly trolley" have certainly reached the last ditch in the way of argument when they suggest that the ringing of the warning gong by the motorman is calculated to hypnotize persons crossing the tracks, so that they will stand stock still and let themselves be run over.—*Providence Journal.*

ELECTRICITY AT WESLEYAN UNIVERSITY.

THE wonderful growth of electrical industries during recent years has greatly increased the demand for young men educated in the science and practice of electricity. In response to this demand, technological schools and State universities especially have established courses in electrical engineering, and from them a great many young men are graduated every year. But the colleges of the eastern and middle states, as a rule, have been slow to provide the increased facilities for instruction in electricity for which there is a growing demand. This demand was early felt at Wesleyan University, Middletown, Conn., and when in 1890 a steam heating plant was installed, space was provided in the boiler house for a dynamo and engine-room, and in 1891 an appropriation was made for machines and apparatus.

The trustees did not wish to establish a course in electrical engineering, but rather to provide adequate facilities for a thoroughly modern course in theoretical and applied electricity. To this end they not only greatly increased the material resources of the department, but also strengthened the corps of instruction. Prof. Morris B. Crawford, with an assistant, had previously conducted the Department of Physics. Prof. Edward B. Rosa, who had just taken his Doctor's degree at Johns Hopkins University, and Mr. Olin S. Blakeslee, mechanician in the Department

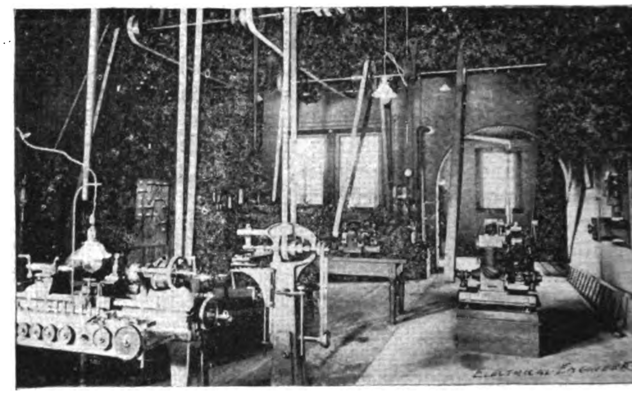


OBSERVATORY HALL, WESLEYAN UNIVERSITY, MIDDLETOWN, CONN.

of Civil Engineering at Cornell, were added to the department. Both laboratory and lecture courses have been extended and instruction is offered to a few graduate students who are conducted to the Master's degree. There are now 12 courses in the department, fully one-half of which are in electricity, and a student wishing to make a specialty of electricity can find continuous instruction in lecture-room and laboratory for at least three or four years. Very few even of our largest colleges offer a more extensive course in electricity than does Wesleyan.

Observatory Hall, shown in the engraving Fig. 1, is one of the oldest of the college buildings. The dome contains a fine 12-inch telescope, whence the building takes its name. Classes in mathematics, astronomy, electricity and general physics meet in the lecture-rooms on the third floor, and the Laboratory of General Physics, exclusive of electricity, is on the main floor. Prof. Crawford has charge of this laboratory and gives the principal courses in mechanics, sound, heat and light. Prof. Rosa gives the greater part of the instruction in electricity and has charge of the Electrical Laboratory, situated about 200 yards north of Observatory Hall.

Fig. 2 shows the dynamo-room, which contains, besides the engine and electric generators, an outfit of machine tools including a milling machine, a drill press, an engine lathe and a fine watchmaker's lathe and numerous hand tools. Here many of the instruments used in the Electrical Laboratory have been constructed. Some of the advanced students manufacture experimental apparatus in whole or in part. Whether a student intends to teach or to engage in original research, facility in the use of tools is desirable;

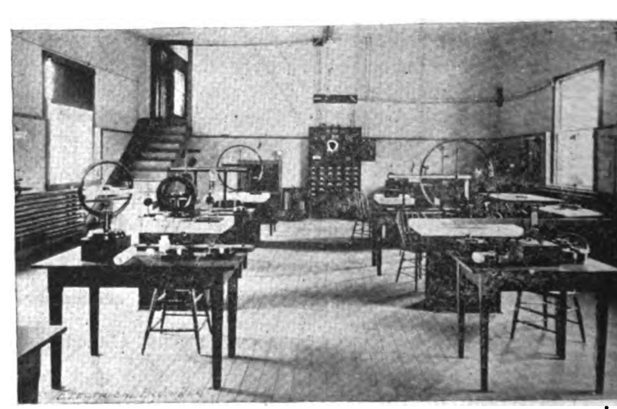


DYNAMO ROOM, ELECTRICAL ENGINEERING DEPARTMENT, WESLEYAN UNIVERSITY.

hence any disposition on the part of a student to work in the shop is encouraged. But shop practice as a part of the course is not required.

This building also contains a six, a three, and a ½ kilowatt Edison generator, and a Westinghouse alternator, built for experimental purposes; besides these there are direct and alternating current motors, transformers and various testing apparatus. The currents are run through various styles of wattmeters, and all circuits terminate in a handsome switchboard, constructed in the building; this in turn is joined to a second switchboard in the Electrical Laboratory, where also the storage battery is located. A convenient means has been devised whereby the battery is charged when the engine is not running. The 220-volt city circuit runs up to the college to supply a motor for some special experiments in another building. The storage battery is joined in series with a 110-volt motor, and so charged when the motor (which runs the machine tools when steam is not up for the engine) is running. By throwing the switch the motor may be run from the storage battery. In this building some of the latest experiments of Elihu Thomson and Nikola Tesla have been repeated, and the more advanced students do dynamo and motor testing, and other work profitable to young men taking a course in modern electricity.

A view of the main room of the Electrical Laboratory is shown in Fig. 3. This building is situated far enough from



INSTRUMENT ROOM, ELECTRICAL ENGINEERING DEPARTMENT, WESLEYAN UNIVERSITY.

the engine and boiler house to render the magnetic disturbance due to the latter quite inappreciable. To further aid in securing an undisturbed magnetic field, all steam, water and gas pipes are of brass, and there is almost no

iron fixed in the building. The precautions taken were ample, and very delicate measurements of electric and magnetic quantities are possible.

There are six piers with marble tops in this room, and each is joined to the switchboard. Thus any number of accumulators or any machine in the dynamo room may be joined through the very complete switchboards to any pier or table in this building. Much of the best apparatus found here, as well as a great deal of simpler lecture room apparatus, has been constructed by Mr. Blakeslee. Among the apparatus designed and constructed during the past two years are a differential wattmeter, an electrodynamometer, two tangent galvanometers with 30-inch circle, several sensitive mirror galvanometers, a large induction coil and numerous rheostats.

The laboratory is quite well supplied with a variety of apparatus for all kinds of experimental work, but much more apparatus is needed, and it is hoped that at no distant day this need will be supplied. Special attention is paid to the very interesting and fruitful field of alternating currents, both in theoretical and laboratory work. Graduate students engage in research as a part of their work for the Master's degree. Prof. Rosa has been engaged during the past year in designing and constructing a large respiration calorimeter for measuring animal heat and in which electricity plays an important part. It will be used in studying the law of conservation of energy in the animal organism. An account of this very elaborate and highly interesting investigation will probably be given at a later date.

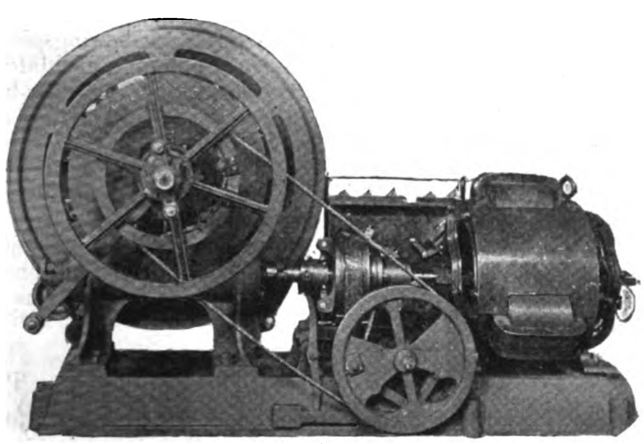
Although the trustees at present have no intention of separating the electrical work from the Department of Physics and creating a separate electrical department, yet the magnitude of the work in electricity and the probable further expansion when a new physical laboratory shall be secured render it quite possible that such a separation may yet be made.

While Wesleyan's facilities for instruction and investigation in electricity are, as will be seen, much less extensive than those of some other larger institutions, it is gratifying to see a classical institution in New England so progressive in meeting a demand for thorough training in modern electricity for men who do not wish to attend a technical school, at least until after graduating from a regular college course.

WORLD'S FAIR DEPARTMENT.

THE ELEKTRON ELEVATOR MECHANISM AT THE FAIR.

In our issue of August 9, reference was made to the Elektron Manufacturing Company's exhibit and to the elevator mechanism there shown. I now have pleasure in giving a cut of the apparatus, a few words of recapitulation in regard to which will not be out of place.



Elektron Elevator Mechanism at the World's Fair.

The motor is a six-pole 500-volt Perret machine of 10 h. p. with a series connection between the armature and commutator permitting the use of only two carbon pencil brushes instead of six and reducing the noise materially. The motor is directly connected to a worm shaft by an universal coupler so arranged that the worm and motor shafts can thrust either way independently. The worm is cut directly on the shaft instead of being sleeved, and the gear is of bronze, hob cut, by Brown & Sharpe, with a ratio of 1 to 40 with the worm, and is bolted to a wide web which, besides being keyed to the drum shaft is bolted directly to the drum as an additional precaution in case of the key working loose.

The elevator hand rope throws in the starting switch and at the same instant releases a brake strap extending $\frac{4}{5}$ of the way around a brake wheel on the worm shaft, which is re-applied when the switch is opened to stop the car by the action of a heavy weight at the end of a compound lever. The brake shaft is directly connected to, though insulated from, the switch mechanism, and in neither direction of running is the circuit completed until after the pole changer has been thrown into contact. In the starting rheostat, a flexible connection, independent of the contact bar, is employed to conduct the current to the solenoid, and the resistance is thrown in ready for starting, the instant the circuit is broken. It thus acts as a safety device in case of an accidental break in the line.

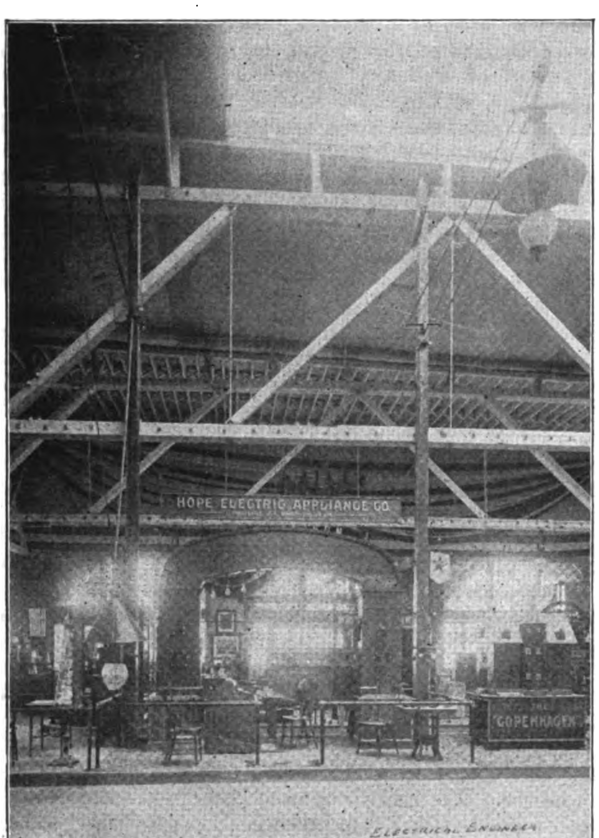
It sometimes occurs that an elevator car sticks in the guides, in which case if the car is coming down and the machinery is not stopped, the ropes are apt to become tangled and give trouble. This possibility is also taken into account and provided for by an ingenious and simple device. The hoisting rope as it leaves the drum passes beneath a loose sheave on a frame whose ends are fixed to loose collars surrounding the drum shaft. At the end next the motor is a catch holding back one half of a clutch turning with the shaft capable of sliding along it when released, under the action of a spring-actuated collar. The other half of the clutch is fixed to the motor-controlling sheave to which the hand-rope is attached. When thus, by reason of the car's sticking on its downward trip, the hoisting rope becomes slack, the sheave under which the ropes pass is no longer supported and, with its frame, falls, releasing the movable half of the clutch which immediately unmeshes with that on the controller sheave and cuts out the motor. To guard against "racing," there are two weights inside the drum acting like governor balls, and when the speed becomes too great, releasing a heavy weight that sets a hand brake and brings the drum to rest. As an additional safeguard against accident from allowing the car to go too far in either direction, a traveling nut on the controller sheave shaft may be set so as to engage, at the desired instant, a fixed nut at either end of its rim and automatically cut out the motor. The rheostat is not mechanically connected in any way with any of the other apparatus and may be placed in any convenient spot.

EXHIBIT OF THE HOPE ELECTRIC APPLIANCE COMPANY.

In section S, space 2, in the southwest corner of the gallery of the Electricity Building, is the exhibit of the Hope Electric Appliance Company of Providence, R. I., manufacturers of mast arms, and cut-out boxes for continuous and alternating currents. The appliances which this company are showing are of especial interest to central station men and construction companies. Prominent among them is the automatic mast arm shown in the engraving of the exhibit, adapted to ordinary thoroughfares. Some of its notable features are an automatic cut-out, which is positive in its action, and, when the lamp is lowered to be trimmed, it is impossible for the trimmer to make a ground, as the circuit is broken at the trunk line. The cutting out of the lamp takes place automatically after it has descended 18 inches, and it is cut in again within 18 inches of its former position.

The lamp is held in place by a metallic tape made of aluminum and bronze, which will not corrode or rust, and is guaranteed to sustain a weight of 600 pounds. This tape runs through a stationary arm, down the pole to a capstan, three inches in diameter. This is enclosed in a neat iron case, and all the trimmer has to do to lower the lamp, is to insert a key crank, and control the downward course by a strap brake, which encircles the drum. This arm complete does not weigh more than 100 pounds, and when put in position, does not interfere with the carrying of trunk lines upon the same pole from which the lamp is suspended.

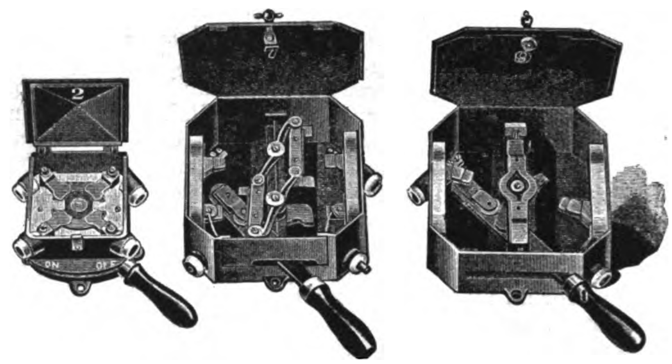
The trolley arm, also shown in the engraving, is made for thoroughfares too narrow for the use of an automatic arm,



The Hope Electric Appliance Co.'s Exhibit.

or traversed by trolley roads. It is simple in construction, and efficient in service. In order to trim the lamp, a man must climb the pole, which is provided with pole-steps. The lamp carriage is fastened to a continuous cable, and is run in and out on a rod that acts both as a track and stay. This arm is also provided with a cut-out, so that in case of necessity, the lamp may be handled with perfect safety while the current is on.

The company make an excellent display of cut-out boxes, some of which are shown in Figs. 1, 2 and 3. The series



Figs. 1, 2 and 3.—The Hope Electric Appliance Co.'s Cut-Out Boxes.

circuit arc box, Fig. 1, is only 7 x 5½ x 3½ inches in size and is thoroughly protected from the weather for out-of-door use. The terminals and rotating contact-block are mounted on a porcelain bed forming the centre partition of the iron case. The inlets through which the conductors pass are insulated with porcelain and no cross-circuits are possible, and the slightest movement of the lever past the centre is independently continued by the springs drawing the links together.

The multiple arc cut-out for high potentials, continuous or alternating, is operated by a lever carrying a roller-bearing which, when moved past the centre of the curved cross-arm, depresses the side towards which the lever is traveling, partially rotating the shaft secured to the cross-arm, and compelling the connecting-plates to abruptly disrupt or to complete the circuit. The construction of the apparatus is substantial throughout; the connecting-plates and contact-posts are mounted on thick porcelain insulators, and the conductors are carried through the sides of the box by porcelain grommets. The dimensions of this box are 8½ x 8½ x 3½ inches, and it is supplied with safety fuse wires when used on the main circuit, outside of the converter. The same operating mechanism is also used in the Wright bi-polar box, for use on primary circuits, Fig. 3.

The apparatus is well arranged and in such a manner as to draw the visitor's attention immediately to its essential features and impress upon him their special claims to superiority.

WESTON INSTRUMENTS CHOSEN.

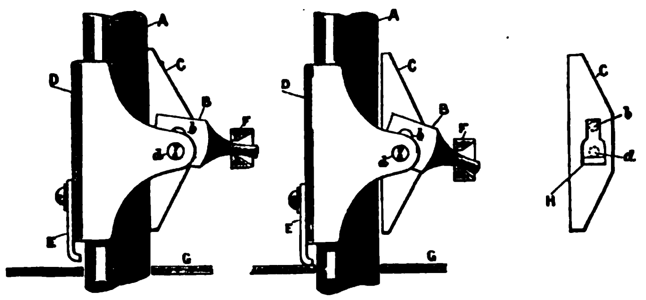
The Weston measuring instruments have been adopted at the suggestion of Prof. Ayrton for all tests made by the Committee of Judges in the Department of Electricity. A laboratory with all the necessary apparatus has been fitted up in the northwest corner of the building and an exhaustive series of tests will be made.

On Saturday, August 12th, a dinner was given to the foreign members of the electrical Committee of Judges by the American members, as a farewell to Director Rathenau and Baurath Ulbricht, of the Committee, who expects to return to Germany within the next few days. The dinner took place at the Chicago Beach Hotel and was a highly enjoyable affair.

The Attendance at the World's Fair during August, has been largely increased over that of any other month, and the generally cool weather has done much to offset the ill effects of financial depression. The people may not spend so much as they intended, but they are there.

THE BRUSH-ADAMS ARC LAMP CLUTCH.

Surrounding the Brush exhibit in Electricity Building is a line of double carbon arc lamps whose steady burning is generally remarked. These lamps though employing the clutch principle, so successfully applied by Brush, have



Figs. 1, 2 and 3.—New Form of Clutch in Brush Arc Lamp.

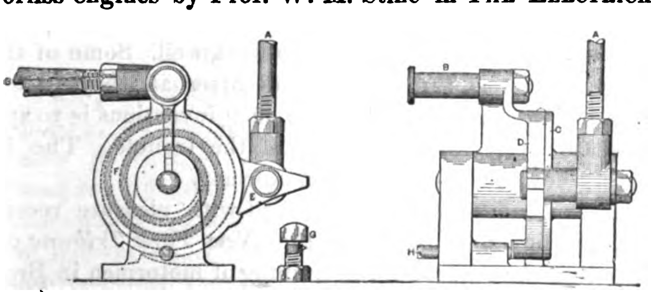
a somewhat different arrangement for releasing the carbon from that originally employed. In the original form Brush, it will be remembered, employed the simple ring or washer, which encircled the carbon rod and the tilting of which, under the action of the magnets, allowed the carbon to feed, or held it in position. The lamps at present manufactured by the Brush Company, however, have a modified clutch arrangement, the joint invention of Mr. Brush and Mr. T. E. Adams, superintendent of the Brush lamp department. A glance at the accompanying illustrations will make clear the new arrangement.

Instead of the ring, a saddle D is employed which is pressed against the rod by a shoe C, both loosely pivotted in the clutch lever B which is acted upon by the arm F which represents the end of the armature controlled by the regulating lamp magnets. Fig. 1 shows the position of the rods where the arc is sprung. As soon as the carbons burn away, the weakening of the regulating magnets allows the armature F to drop as shown somewhat exaggerated in Fig. 2, and releases the lamp rod just sufficiently to allow it to fall a slight amount; but just as soon as it reaches the point where the arc is of normal length the magnets are again energized and the clutch is applied, but at a point a little above its former position, where it is maintained until the carbons require readjustment.

The action of the clutch is imperceptible and the feeding cannot be observed while the lamp is burning.

THE BATES CORLISS AUTOMATIC ENGINE STOP.

In connection with the article on a safety device for Corliss engines by Prof. W. M. Stine in The Electrical



The Bates Corliss Automatic Engine Stop.

Engineer, for July 26, it is interesting to notice an automatic stop used by the Bates Machine Company, of Joilet, Ill., and exhibited by them in Machinery Hall. The device will be readily understood by reference to the accompanying diagrams.

Here C and D are independent discs between which is placed a spring F connected to the hub of C and rim of D. The tension of this spring is resisted by the pawl E on the disc C thus causing discs C and D to work as one. The rod A connects directly to the governor and the rods B are connected to the tripping device at the valve motion. Should any accident befall the governor it would immediately descend until the pawl E came in contact with the adjustable screw G, disengaging it from the disc D and allowing the spring F to throw the rods B back to the earliest point of cut-off, shutting off the steam and stopping the engine. When the engineer stops his engine and the governor descends, he pushes the pin H into a recess in the disc D thus stopping the downward travel of the governor at a point where the pawl E will lack just a trifle of being in contact with the adjustable screw G. When the engine is started again and the governor rises, the pin H is automatically forced out, leaving the automatic stop free to act.

It will thus be seen that the memory of the attendant is not called upon, as the stop sets itself ready for action as the engine gets up to speed.

Letters to the Editor.

THE TROLLEY CURRENT AND TELEPHONE CABLES.

A new form of trouble due to the grounded return current of the electric railway system in Brooklyn, has developed within the last few days.

Yesterday, a corps from the telephone company was engaged in removing a large cable from the conduit on Court street, the lead covering of which had been eaten through by the current from the railway circuit.

The foreman stated, that this was the first cable from which they had had trouble from this cause.

It is very much feared that all the other cables of that line will shortly have to be removed on account of this trouble.

J. Stanford Brown.

126 Liberty street, New York City, August 14, 1893.

THE PRODUCTION OF OZONE ON A COMMERCIAL SCALE.

An interesting plant for the production of ozone on a commercial scale, the invention of M. E. Andreoli, is now in operation at the works of Messrs. Allen and Hanbury, Bethnal Green, E. London. The apparatus used is electrical, the ozonizer consisting of a number of serrated strips formed up into grids, and separated from each other by plates of glass. On connecting these grids with opposite terminals of a high potential alternating current, a brush discharge takes place on to the glass from the points of the serrations, and the characteristic smell of ozone is quickly apparent In practice, where a large quantity of ozone is required, a number of these plates are arranged together in a suitable case, and the discharge having been established, a current of air is sent through the case, whence it issues in a highly ozonized state. To insure the purity of the air used, it is filtered through a cotton filter, and cooled and dried before it is passed into the ozonizer. The electric current is supplied by a one horse-power alternator working at 100 volts, which has been supplied by Messrs. Pyke and Harris. The current obtained from this machine is then transformed up to 10,000 volts by means of a Swinburne transformer, this being the potential used in the ozonizer. It is proposed, amongst other uses for the apparatus, to supply it for ageing wines, beers and spirits. It is claimed that in a few hours, by the use of the ozonizer, raw spirits or new wines may have the same mellowness, flavor, and bouquet imparted to them as if they had been kept in the cellar for years. Another suggested employment for the ozonizer is the preparation of oils for painting, the same result as to drying properties being obtained as by boiling the oil, but combined with a great improvement in its clearness and color. The oils, in fact, are bleached in the process. A further claim is made for the use of ozone in bleaching paper pulp. In combination with chlorine it is asserted that paper pulp can be bleached at from one-half to five-eighths its usual cost.

THE ELWELL PARKER ELECTRIC CO. OF AMERICA.

The above concern, named after a leading English electrical company, has been incorporated at Cleveland, O., with a capital stock of $500,000, to make and sell dynamos, motors and other apparatus. Mr. E. H. Phillips is one of the incorporators.

A NATURAL ERROR.

Our attention has been called to the fact that the item on "Calculating Boys and Puzzled Humorists" which we attributed last week to *London Punch* is from the *London Electrician*. We hasten to make the correction, simply remarking that the mistake was a natural one.

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Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XVI. NEW YORK, AUGUST 23, 1893. No. 277.

THE PRODUCTION OF NEW INCANDESCENT LAMPS.

IT was but to be expected that the restriction put by the courts on several of the manufacturers of incandescent lamps would act as a strong stimulus to the production of forms not falling within the scope of the Edison patent. The activity and ingenuity shown in this branch of work during the past year have been most remarkable, and have in reality given results that constitute a distinct chapter in American electrical invention.

We illustrate one of the new lamps of the new era in this issue, and are constrained to make special note of its appearance on account of the striking facts connected with its invention. For 15 years we had all been practically agreed that one form of lamp presented the maximum of advantage, and it was for the right to make such a lamp, with trifling variations in detail, that the hot battles of the last six months have been waged with such curiously contradictory results. But now, thanks to the work done in old neglected fields, or in new, hitherto untried lines, we are informed that the type of lamp hailed with such acclaim and enthusiasm at the beginning of the last decade was neither finality nor perfection. Some of us had, perhaps, suspected this, but ever since the period when Mr. Weston stopped his interesting experiments on tamidine, there had been little support for the heterodox belief.

To-day, the Beacon Company, whose work has from the outset been marked with unusual originality, step forward and offer their new lamp, not merely as an evasion of the Edison patent, but as a distinct invention and as an advance in the art. It is noteworthy that its chamber is not an all-glass globe and that the leading-in wires do not pass through glass. The cement is also an interesting feature, and the small radiators to carry off the heat of the leading-in wires are a marked novelty. It is asserted that this lamp is cheaper of production than any old style, and that the manufacturers prefer to give their attention to it for cogent economical reasons. We cannot say anything in support of this ourselves, having no intimate knowledge on the point; but if it be true, the reward is none too great for the courage and genius that has led the company forward to their goal. We shall be interested to note the performance of these lamps, and are meantime gratified to learn from the makers that months of trial and experience with thousands of them have proved very satisfactory and encouraging.

Just what the ideas of the Beacon Company are on the value or propriety of a patent monopoly we are not fully informed, but we desire to give publicity to their statement that they will allow others to use the inventions embodied in the lamp on the same royalty that they will have to pay the patentees. Such a practice would in the long run, of course, tend to uniformity of product, just as does a monopoly, because it permits no variation; but the point of departure is so different that it is possible material advantages may be derived. The idea is in essence that which we urged upon the General Electric Company, when it began its campaign of threats and injunctions, and when it might still have maintained its position of superiority without hampering industries from whose demoralization it is now one of the sufferers.

The world moves. Some remote day, to have lighted our homes and offices with white-hot filaments will appear as foolish and barbarous as to have warmed them with red-hot pokers; but at present the incandescent lamp is the highest product of genius in electrical illumination. It can only be further perfected by such work as that to which the Beacon Company have devoted their resources without stint; and we are heartily glad to congratulate that company upon their courage, their enterprise and their success.

TRAINING THE MOTORMAN.

WE note of late a great increase in the number of patents the object of which is to rescue from danger persons who are run down by trolley cars. Some of these patents are most ingenious and ought to work well. Some of them deserve trial and adoption, But after all, they give the impression that the tendency of such inventions is to apply the remedy at the wrong end of the trouble. The best safety device is a competent motorman.

In this connection we have read with pleasure recently an intelligent editorial in the *New York Tribune* commending the school for the training of motormen in Brooklyn. One passage is as follows:

> No man in our cities is allowed to run a steam engine, the mismanagement of which might endanger human lives and property, without having passed an examination to determine whether he understands his business and is able to perform it properly and safely. The laws on this subject are wholesome and sound. No one would think for a moment of abrogating them, or of permitting steam engines to be placed in charge of men not known to understand their management thoroughly. Is it not absurd, therefore, to allow trolley cars to be run by men who know nothing, or next to nothing about electricity, and who have undergone no special training for the novel and dangerous work they

are called on to perform? To run an electric motor by means of a trolley requires greater skill and caution than to manage a steam engine. Now that the trolley is being used on so large a scale in so many cities, it certainly seems that the time has come for the enactment of a law requiring all railway companies to employ no motormen except those who have submitted to examination in order to prove their fitness for the work entrusted to them.

No great objection can be found to this. As a matter of fact, the training of motormen is carried on very extensively, but we confess to a doubt whether the pace of tuition is not rather rushed sometimes, and whether the men are always invited by praise and promotion to be as careful as they might be.

We have two instances in mind where accidents might have been avoided, but where the passengers were deliberately exposed to danger. In one case, in a city up the Hudson, the motorman found the brake mechanism of his car out of order and at once reported it. The report was unheeded, the car went out on the road, and it was not long before that car, patterning after Maine when it went for Governor Kent, had smashed up things in a very lively and sulphurous manner. In the other case, in Jersey, a callow boy of seventeen, put in temporary charge of a car, amused himself by rushing it up to the one in front of him, and making it stop just when a collision impended. At last it bucked a little too strongly and there was a glorious smash.

Both incidents are unworthy the electric railway industry. Both are of the kind that provokes criticism which cannot be answered, bringing condemnation on the trolley entirely unfair yet wholly natural. We agree with the *Tribune* that the training of motormen is an essential precaution, but we think that the training and the care should begin a little higher up. The report of Mr. Hewitt printed in our columns a couple of weeks ago, was eloquent testimony to the need of vigilant, systematic and intelligent management. Too many of the local street railway companies, we fear, have had the notion that the only thing necessary to roll up the dividends was to "adopt electricity." They have lost sight of the simple fact that employees, generating plant, rolling stock and track must all be kept at the highest point of efficiency, if the best returns are to be derived from the use of electricity. Where there is careless or indifferent management, it is much cheaper to run the road with mules.

GENERAL ELECTRIC.

The price of General Electric shares hangs around 40, running, for the most part, rather above that figure than below it for the past fortnight. The financing of the Company's floating debt of about $4,000,000, undertaken some weeks ago, and now apparently about completed, has not had the effect of maintaining the advance in the shares observed since the underwriting of the debt subscription was announced. The reason is not far to seek; for while there can be no question of the expediency and wisdom of extinguishing the current debt, the means employed to do it are necessarily costly to the company at such a time as the present; involving a considerable sacrifice on the assets transferred to the people who furnish the money. It is quite clear that the subscribers to the stock of the Electric Traction and Illuminating Trust (the title of the new "series" organization as given by the *Boston Herald*) which is to take over from the General Electric Company securities to the face value of some ten to twelve millions, expect to make a handsome profit on their investment. This is especially likely to be true of the underwriters of the subscription. It is stated in Boston that the General Company is to receive $4,500,000 for the stocks, bonds and receivables to be turned over, less 10 per cent.—$450,000—which is to go to the underwriters. It is understood that the subscription is offered to all General Electric stockholders, who may thus share in the prospective profit on the securities transferred. Probably many will be unable to subscribe and some may be unwilling to do so. Be their number many or few, the estimated present value of the assets of the General Company must be diminished by an amount nearly commensurate with the prospective profit to the investors in the new securities company, however the transaction may improve the credit of the General Company. Under the circumstances we do not believe that the management of the Company are paying too high a price for the financial relief secured. They are simply reaping the fruits of the policy pursued so long by the Thomson-Houston people of spending good money in the manufacture of goods and selling the product, in large part, for stocks and bonds of uncertain value. It is to be hoped there is truth in the reported determination of the directors of the General Company to abandon wholly the old method and to sell for cash or its equivalent only, in the future.

We place no credence in the often reiterated rumors of an impending reorganization of the company and of wholesale changes in the personnel of the management. There seems, however, to be no doubt that its affairs are being closely examined by competent persons, in the interest of large holders of the stock, with the view to a reduction of expenses and more conservative methods of business.

INTERNATIONAL COURTESIES.

The dinner given last week at Manhattan Beach, on the initiative of Mr. John W. Mackay, was a felicitous courtesy, and the recipients of American hospitality on this occasion were peculiarly representative men. Nowhere is the name of Siemens more honored and respected than in America. Most American electricians have a conviction that Mr. Preece is himself the main argument for government telegraphs, and that without him, their marked efficiency would no longer be a favorite topic with the advocates of centralizing the control of such institutions in the government. As for Prof. Jamieson it is not too much to say that his old pupils are among the most successful of the electrical engineers who come from Great Britain to try their fortunes; while go where you will, "Munro & Jamieson" is the one book that the practical man insists on having. We are indebted in this country, for many things, to such men as Preece, Siemens and Jamieson, and are happy to have them among us, with many others now on this side the ocean, to show them how high they stand in our esteem, and how anxious we are to work with them in maintaining a high ideal for one of the noblest of professions. One of the benefits of International Congresses is not only that they standardize values and units, but promote good feeling and friendliness among nations.

MISCELLANEOUS.

THE PREVENTION AND CONTROL OF SPARKING.[1]

BY W. B. SAYERS.

IN the course of the discussion upon my paper dealing with the control of sparking in short air-space dynamos, Mr. A. P. Trotter and several other gentlemen suggested that I should give some definite information about the relative cost and efficiency of a machine on my principle, compared with an ordinary smooth-core machine. In complying with these requests it seemed to me that I could not do better than compare a machine of my design with the Edison-Hopkinson machine, which was described in the celebrated paper on "Dynamo-Electric Machinery," by Drs. J. and E. Hopkinson, read before the Royal Society in 1886.

The particulars of the Edison-Hopkinson machine given herein are partly taken from Dr. S. P. Thompson's "Dynamo-Electric Machinery," and partly from specimens of the machine, several of which I have had experience of from time to time. There is no sparking whatever at the brushes of this machine when working at full load, and I believe the limit of output is fixed by the heating and by the mechanical strength of the armature. I have, therefore, in my design kept the total magnetic flux through the armature, and also the magnetic density, the same as in the Edison-Hopkinson machine.

The total flux through armature core when the machine is running without load is about 10,530,000 C. G. S. units.

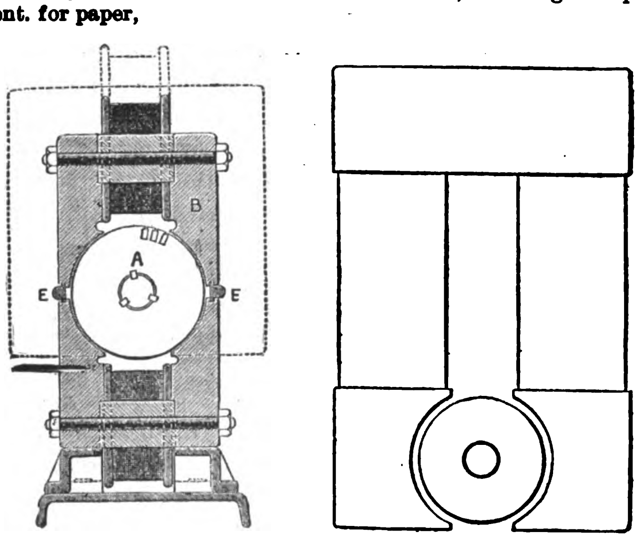
The E. M. F. is generated by 20 coils in series, which cut the field of force four times per revolution. We have, therefore, if we take the speed at 750 revolutions per minute,

$$E = \frac{10{,}530{,}000 \times (4 \times 20) \times 750}{60 \times 10^8} = 105 \text{ volts.}$$

In my design I make the number of coils on the armature 38, and the E. M. F. is generated by 19 coils in series and two "commutator coils," or "reverser bars," as I prefer to call them in a machine of this size, because they only pass once from end to end of the armature, without going round the ends. The two reverser bars add an E. M. F. equal to one main armature coil, because, although the E. M. F. induced in one of them is only half that induced in an armature turn, they carry the whole current, and thus add their half-turn E. M. F. to both halves of armature. Thus we have

$$E = \frac{10{,}530{,}000 \times 4 \times \{ (19 + 0.5 \times 2) \} \times 750}{60 \times 10^8} = 105 \text{ volts.}$$

The diameter of the new armature over all is 11¼ inches; at the bottom of the tunnels, 9¼ inches; and of the hole through the centre, 3 inches. The length of the core is 20 inches. The area of the iron in the core of the armature is thus, allowing five per cent. for paper,



FIGS. 2 AND 3.

$$20 \times (9.25 - 3) \times 6.45 \times \frac{95}{100} = 768 \text{ square centimetres.}^2$$

The induction density in the armature core will be

$$\frac{10{,}530{,}000}{768} = 13{,}700.$$

The air space I make 0.25 centimetre, or about 0.1 inch. The tunnels are shown in full size in Fig. 1; they are 0.125 inch below the surface, 0.875 inch deep, and 0.487 inch wide. The crown of the tunnel is slotted through to lessen the self-induction of the conductors.

The main winding would be of rectangular conductors 0.3 inch x 0.25 inch, and the "commutator coil," or reverser bar 0.3 inch x 0.15 inch. These conductors and the tunnels which contain them are shown in section, full size, in Fig. 1. The main conductors C, may advantageously be made up of eight wires of rectangular section, covered together so as to form a stranded conductor. The object of the stranding is to facilitate bending. The current density at full load of 320 amperes will be 2,150 amperes per square inch, against 2,460 in the Edison-Hopkinson machine.

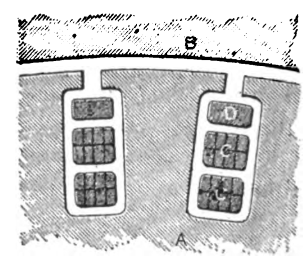


FIG. 1.—SAYERS DYNAMO ARMATURE.

The construction of such an armature presents no difficulty whatever. The holes to form the tunnels are punched in the discs before putting together, and are made a trifle larger than the required size of tunnel to allow of slight inaccuracies in the punching. Lengths of main conductor, each sufficient to form one coil, may then be cut off and formed into U-shaped loops. The two loops—section through one leg of each of which is shown at C, Fig. 1—which go into the same tunnel can be taped together, and the reverser bars—section of one of which is shown at D, Fig. 1—with them, and then slid in from the commutator end. When all the U-shaped loops are in position, their free ends may be bent and connected up in the same manner as that adopted in the Edison-Hopkinson armatures, so as to form the main winding; but instead of soldering the ends of the coils into the commutator lugs at the time of connecting up, as is done in the Edison-Hopkinson armature, the ends of the reverser bars can be soldered to the points of connection between the coils at the same time as they are connected up. The reverser bars run back through the tunnels to the commutator. Fig 2 represents in section at right angles to shaft the new design. Fig. 3 represents the end view of iron only of Edison-Hopkinson machine, to same scale.

The dotted line in Fig. 2 indicates a single-limb magnet. A great additional saving of weight, however, is obtained by making a double magnet, as shown in full; and the value of the iron saved more than covers that of the additional wire required. The top and bottom halves of the magnets are separated by four brass distance pieces of the section shown at E. These may be, say, 3 inches long, and placed one at each corner of the magnet limbs; gaps will thus be left for ventilation. Below are given the comparative electrical data, weights and values of material in the two designs.

ELECTRICAL DATA.—*Armature.*

	Edison-Hopkinson.	Sayers.
Cross-section of conductor............	0.065 sq. in.	0.075 sq. in.
Current density...	2,460 amps. per sq. in.	2,150 amps. per sq. in.
Resistance at 100 deg. F.....	9.008 ohm.	0.0067 ohm.
" of two reverser bars,........	....	0.001 "
Total resistance between brushes......	0.008 ohm.	0.0077 "

Field Magnets.

Resistance of magnet coil.	Edison-Hopkinson.	Sayers.
Say 15,000 ft. No. 13 wire............. ..	16.93 ohms.	....
If single magnet, 14,000 ft. No. 19 wire...	...	82 ohms.
If double magnet, 14,000 ft. No. 17 wire.	....	43 "
Current...................	6 ampers.	. .
If single magnet........	...	1.28 amperes.
If double magnet.............	...	2.56 "
Ampere turns in shunt coils............	19,600	3,600

1. From the *Journal* of the Institution of Electrical Engineers.

2. The area of iron of core of armature of E. H. machine is given in Dr. Thompson's book as 810 square centimetres, but apparently this has been reduced, as the cores of two armatures which I have had the opportunity of measuring have only had a section of about 770 square centimetres of iron, excluding the three discs of ⅜ inch thickness which are in the Edison-Hopkinson armatures.

WEIGHTS AND VALUES.

	Edison-Hopkinson.			Sayers.		
	Weight.	Rate.	Value.	Weight.	Rate.	Value.
			£ s. d.			£ s. d.
Armature discs	3.7 cwt.	32s.	5 18 0	4.7 cwt.	32s.	7 10 0
Armature conductor.	60 lb.	9d.	2 5 0	67 lb.	1s.	3 7 0
Reverser bars........	....	....	....	11.5 lb.	9d.	0 8 8
Magnet cores........	31.7 cwt.	12s.	19 0 0	12.2 cwt.	12s.	7 6 0
Magnet wire	410 lb.	9d.	15 6 0	141 lb	10d.	5 17 6
Total weights of parts enumerated above..............	39.5 cwt.		42 9 0	18.8 cwt.		24 9 2

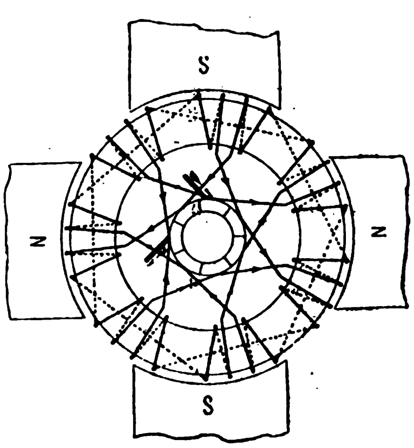
There will be a further saving of weight of material in the bedplate on account of the lighter magnets; and if required compound-wound, the whole cost of material and labor for this will be saved, as the new design will "compound" without any series coils.

As regards the cost of workmanship, so much depends on the details of the design, and the means employed for performing the various operations, that I think it would hardly serve any useful purpose to give my estimate for these.

In addition to the saving in weight and cost of materials, I must claim for the new design great superiority from a mechanical point of view. Each disc of the armature is positively driven by the three keys upon which it is supported; the conductors are positively driven—whether or not there is any force exerted upon them; and the armature presents a smooth iron surface which is not liable to damage from careless or unskillful treatment. The space left for insulating material in Fig. 2 is ample for 100 volts, as I have proved by considerable experience: the normal insulation resistance to iron in such an armature would be two or three megohms. If a much higher voltage were required, the tunnels would be made deeper, so as to provide space for additional thickness of insulation, the diameter of the armature being increased to allow of the deeper tunnels.

A NEW ARMATURE WINDING.

THE accompanying figure shows a new kind of armature winding, which has been designed by Ludwig Baumgart, and which is intended chiefly for use with high-voltage four-pole machines. It is described in the *Elektrotechnische Zeitschrift* and is, as will be seen, a form intermediate between ring and drum forms, having twice as many wires outside as in; hence its value in high-pressure work. The author observes that for such uses machines may be conveniently made four-pole, and the addition of this armature,



THE BAUMGART ARMATURE WINDING.

or one wound on a similar principle, enables full advantage to be taken of the increase in the number of poles in increasing the voltage. The armature has some of the advantages of the Gramme form, and is free from all patent rights.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have received the contract for the new power station for the Atlantic Improvement Co., Astoria, L. I. There will be two buildings, a boiler house 62 feet wide and 85 feet long, with a dynamo room 70 feet wide and 180 feet long. The dynamo room is controlled by a traveling crane to be furnished by the same parties.

McINTOSH, SEYMOUR & CO.'S ENGINES IN THE NEW ELMIRA, N. Y. CENTRAL STATION.

THE new station of the Elmira Electric Light Co., of Elmira, N. Y., is now rapidly nearing completion and its design reflects great credit on Mr. F. A. Cheney, the general manager of the company.

In order to give our readers some idea of the arrangement adopted for driving the arc machines we reproduce in Fig. 1 a

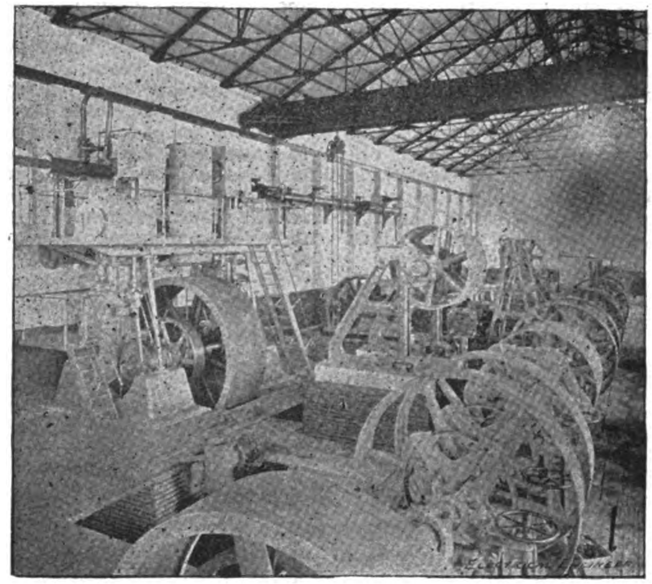


FIG. 1.—McINTOSH, SEYMOUR & CO.'S ENGINES IN THE NEW ELMIRA, N. Y. CENTRAL STATION.

view of one side of the engine room, taken a short while ago. The main lighting engine shown was built by Messrs. McIntosh, Seymour & Co., of Auburn, N. Y., and is of the four cylinder triple expansion type, high pressure and intermediate cylinders each tandem with one of the two low pressure cylinders.

The frame supporting the cylinders consists of a heavy cast iron box-form upright, bolted to the bed plates on one side of the engine, and turned forged steel columns on the other side, with flanges forged on their ends to bolt to the bed-plates and cylinder heads. The rear upright is made very heavy, and stiff enough to serve even though the steel columns were removed. The latter can be taken out, and the entire engine is very easy of access. The connecting supports between the low pressure cylinders and the high and intermediate are so arranged that the upper low pressure cylinder heads can be removed without disturbing these supports.

There are no stuffing boxes between the cylinders, a packing sleeve taking their place. This consists of a long tube babbitted and bored out to fit the piston rod. It has a large surface, and acts as a guide to the pistons and rod, greatly adding to the smooth running of the engine, in addition to the advantage of doing away with the stuffing boxes, and preventing leakage from one cylinder to another.

The cylinders are provided with the regular double valve arrangement of the manufacturers, whereby the opening and closing of the exhaust, and admission of the steam is regulated by fixed eccentrics, driving the main valves, and the cut off is controlled by an auxiliary valve driven by the governor, this valve being placed on all the cylinders.

A practically similar arrangement of the cylinders is employed on the McIntosh-Seymour 1200 h. p. horizontal engine in Machinery Hall at the World's Fair, and is illustrated in Fig. 2, which shows a section through the cylinder.

The governor consists of an arrangement whereby the auxiliary or cut-off valve eccentrics are merely turned around on the shaft by the centrifugal weights, the eccentrics being free to so turn, and their position being controlled by the governor weights. The closing of the valves is as rapid as with any gear known, and by a series of variable strokes with the auxiliary valves, the load is divided equally between the cylinders, and also the drop in temperature between the initial and exhaust temperature in each cylinder. This makes the engine work under the best conditions under all loads without any hand adjustment. The main valves are provided with patent adjustable seats. These seats are well known, and have been in use for a long time, and proved their efficiency in preventing leakage. The valves, valve gear and eccentrics are so counterbalanced that they are in static equilibrium.

The running parts of the engine have all been carefully worked

out. The crosshead is of one piece of phosphor bronze of the slipper type. The guides are bolted to the upright, and are removable and adjustable for wear and are water-jacketed. The connecting rod is of the standard gib and key type. The shaft is made of open hearth steel, and also the crank pins, both being forced into the discs, which are made of charcoal iron.

Messrs. McIntosh, Seymour & Co. pour the important parts, such as discs, cylinders, etc., from special heats of hard, close-grained charcoal iron. The shaft is provided with outside cranks at right angles to each other, and fly wheel between the two halves of the engine, the frames being connected by stiff wrought steel braces, supporting platforms and receiver.

The main bearings are provided with removable cast iron shells, lined with anti-friction metal, and water jacketed. They are so arranged that by lifting the shaft and wheel slightly by screws which are provided for this purpose, under the discs, they can be removed without disconnecting any gear of the engine, the entire operation taking only a few minutes. This is a great convenience, if it is desired to examine or gain access to the main bearings, and will be appreciated by engineers. The high pressure cylinder is steam jacketed, and the intermediate and low pressure cylinders are provided with receivers of large capacity having brass heating coils. The receivers and cylinders are lagged with iron made to represent wood, covering a thick layer of asbestos fibre. Each side of the engine is provided with oil tanks with sight feed outlets, and leading pipes to each bearing and pin requiring constant lubrication, and the beds are provided with pockets for catching all oil.

The weight of the engine complete is about 115,000 lbs., the driving wheel being 12 feet in diameter by 52 inches face, and weighing 20,000 lbs.

The engine has a high pressure cylinder 14 inches in diameter; intermediate 23 inches, and two low pressure cylinders 26 inches in diameter each, all having a stroke of 24 inches. It runs at 137 revolutions a minute, and will develop 500 h. p. with 150 lbs. pressure condensing. The engine is designed to run ordinarily at 150 revolutions, and to develop 600 h. p. The construction of this engine is so thorough and massive that there is no perceptible vibration of the upper platforms at speeds of 30 or 40 revolutions above that for which it was designed; and the smooth running of the engine is favorably commented upon by all observers.

The engine has just been put into service, and the very best results in economy of fuel are expected. It condenses into a Blake independent condenser, and has a suction pipe about 4,000 feet long.

Besides the vertical triple expansion engine in question above described, there is a pair of McIntosh & Seymour horizontal railroad engines coupled together, which belt direct to Westinghouse and Edison generators. These engines are coupled to opposite ends of a short shaft by friction clutch couplings making a very flexible arrangement. The boiler plant consists of vertical high pressure boilers, having many interesting features.

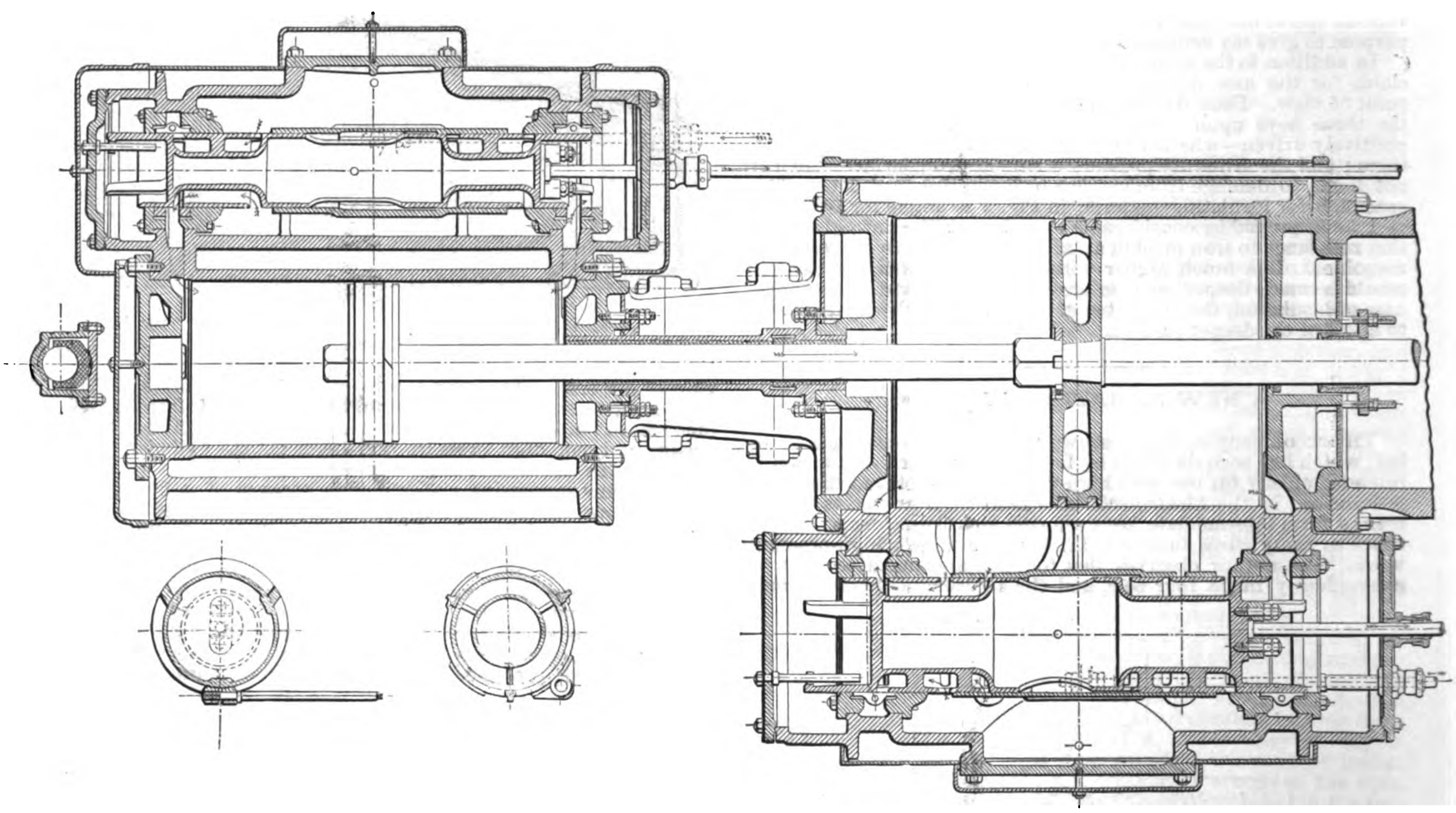


Fig. 2.—Section Through Cylinder, McIntosh & Seymour Engine.

INFLUENCE OF ELECTRODES ON ELECTROLYTIC DEPOSITION.

According to Faraday's electrolytic law we ought to obtain the same amount of metal deposited on the anode, for a given current, whatever the composition of the electrodes. However, Dr. Oettel (*Chemiker Zeitung*) finds that with platinum electrodes the deposit of copper is only from 74 to 89 per cent. of that obtained with copper electrodes, the density of the current being 0.13 amperes per square decimetre, and no free hydrogen being liberated. The cause of this divergence is the formation at the anode of persulphuric acid and of hydrogen dioxide, which diffuse in the liquid, and reaching the cathode become reduced, causing a diminution in the quantity of metal deposited. The addition of an easily oxydized body, such as formic acid, annuls the action of these secondary products, and increases the quantity of copper deposited to 98.7-99.6 per cent. of the theoretical quantity. Alcohol is still more efficacious, 99.9 per cent. being obtained.

Dr. Oettel has also investigated the divergences observed in the weight of the deposit in the copper voltameter when an acid solution is employed. The divergences are of such a magnitude that it has been generally recommended to use a perfectly neutral solution, although the resistance is in this case much higher. The author, however, finds that, with a current density less than 0.3 amperes per square decimetre, the neutral solution gives too heavy a deposit. When an acid solution to which alcohol has been added is used, the results agree with those obtained with the silver voltameter. The best results are obtained with a solution consisting of 15 grms. of copper sulphate, five grms. of sulphuric acid, and five grms. of alcohol mixed with 100 grms. of water, the current density being between 0.06 and 1.5 amperes per square decimetre.

THE WISCONSIN ELECTRIC DYNAMO COMPANY.

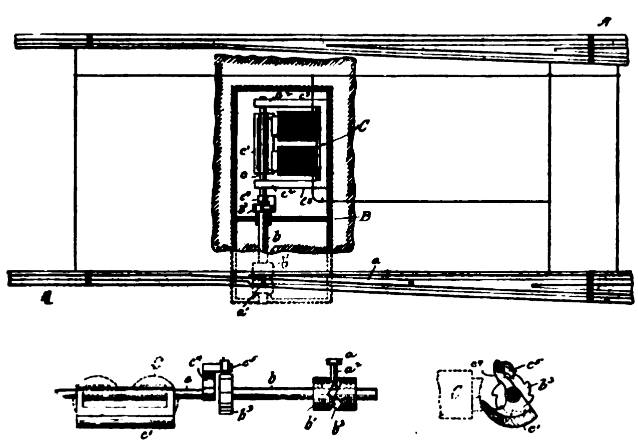
Articles of incorporation have been filed by the Wisconsin Electric Dynamo Company, at Milwaukee, Wis. The company has a capital stock of $50,000, and proposes to manufacture dynamos at Layton Park. G. Podoll is president; F. H. Brockmann, vice-president; John B. Zaun, treasurer, and John M. Brandmueller, secretary.

ELECTRIC RAILWAY DEPARTMENT.

THE FITCH ELECTRIC TONGUE SWITCH.

A SHORT while ago we made mention in these columns of an automatic tongue switch designed for use on electric railways, and which had been put in service on the Steinway electric railway, at Astoria, N. Y. This switch which is operated from the railway circuit is shown in plan in Fig. 1, and Figs. 2 and 3 illustrate the details of the armature and shaft.

The switch apparatus is contained in a cast iron frame set in the ground between the rails, containing the magnet that operates the mechanism and the cam that works the switch. The armature is semi-circular and is mounted on the shaft with a pawl and ratchet connection. The shaft carries at its extremity a cam that operates the switch tongue by means of a pin attached to it. Its operation is as follows: One length of rails, just before reaching the switch, is insulated from the rest of the line. A ground wire is connected with the insulated rails and magnets and thence to the main return. If on approaching the switch, the tongue is turned the right way the current is cut off and the switch made by the momentum of the car. If, on the other hand, the tongue is turned the wrong way the current is left on, and when the car reaches the insulated rails the magnets move the armature which turns the cam by means of the pawl and ratchet, and throws the switch. The construction of the cam is such that the movement



FIGS. 1, 2 AND 3.—THE FITCH ELECTRIC TONGUE SWITCH.

of the armature is sufficient to change the switch, and as the armature always drops back by gravity when the car is past, the switch can be thrown either way from the car when on the insulated section. The insulation required for the rail section is very little and consists only of omitting to bond the rail, and filling the space between its end and the adjoining rail with pitch.

This ingenious switch arrangement is manufactured by Fitch Excelsior Switch Co., of this city.

THE WILCOX ELECTRIC COMPANY.

A NEW electric railway manufacturing concern under the name of the Wilcox Electric Company, has begun business at Newark, N. J., with a capital stock of $150,000. Among those interested are T. B. Wilcox, H. Wilcox, E. R. Dimick and T. B. Huffman, of Newark; J. W. Hinkley, of Poughkeepsie; and W. Gibson, C. E. Peet, G. M. Thompson, G. J. Peet and W. B. Smith, of New York.

THE GRAY ELECTRICAL TRANSIT COMPANY.

THE above named concern has been organized in New Jersey, with a capital stock of $72,000, and with headquarters at Passaic. It will develop some new electric railway inventions. Among those largely interested are F. A. Scheffler, H. F. Gray and E. H. Rose.

THE BANGKOK, SIAM, ELECTRIC ROAD.

THE United States Vice-Consul at Bangkok reports that an electric street car line three miles long has been put into operation by the aid of American enterprise. This is the first electric street car line in the extreme Orient. The receipts of the line have already increased by 30 per cent., and the management contemplates building an extension. The road is equipped with Short electric railway apparatus, as already noted in these columns.

THE EARTH AS AN ELECTRICAL CONDUCTOR.

IN a recent issue of *Science*, Prof A. F. McKissick of the Alabama Polytechnic Institute describes some experiments made by him to determine the availability of the earth as a return conductor for electric railways.

An earth-pit was dug six feet deep, eight feet long, and two feet wide, at each end of the line running from generator at college to motor at experiment station. This line is by measurement 3,000 feet long. A plate of copper, 7 by 2 feet, and a plate of tin of same dimensions, soldered to a No. 0000 B. & S. wire were used as the earth-plate at each end. The plates were packed firmly with charcoal and iron filings and the pit filled with old iron. The water rose in one of the pits to a depth of two feet. With all connections soldered, the resistance measured by a Wheatstone bridge was found to be 102 ohms. Supposing the earth connection was not a good one at each end of the line, an additional earth connection at each end was made by sinking a large piece of iron in a well. With this additional connection there was no appreciable difference in the resistance. Connections to the earth were then made at different distances from the college by connecting one end of a wire to the overhead wire, the other end soldered and tied to a piece of iron six feet long, driven down flush with the ground. These distances were respectively 500, 1,000, 1,500, 2,000 and 2,500 feet from the college. These connections were made at different times, always removing an earth connection when its resistance had been measured. The resistances in the same order were 307, 567, 158, 707 and 217 ohms. The comparatively small resistances of stations three and five are probably explained by the fact that they were located near branches (small streams).

From these results Prof. McKissick concludes that the resistance of the earth is a very unknown quantity, and the assumption that the resistance of the earth can be neglected in any soil is an unsafe one when the object in view is to transmit currents without very much loss.

THE QUESTION OF ELECTRIC CAR BARN CONSTRUCTION.

MR. FRANK B. RAE, the electric railway engineer, of Detroit, Mich., writes us with regard to the use of grades in electric car barns as a precaution against fires:—The matter is one which I have not had occasion to think much about for some time, and the individual situation would of course cover every case. There was one idea that suggested itself to me of putting up two trolley circuits within the barn, one ordinarily connected with the street trolley line, and the other running parallel with it to the junction of the car barn line and the main line. This auxiliary circuit would be connected with the feeder through a switch and would be ordinarily disconnected.

When the cars were run in at night it would be the duty of the car driver to put his trolley upon this auxiliary line and to leave his car switch turned over to the first point in a direction which would run the car out of the house; then in event of fire by throwing switch on the outside into contact with the auxiliary trolley line the cars would move themselves out of the barn.

Ordinarily I think I should prefer level track within the car house, as the cars can be moved with greater facility whether by current or by hand.

This auxiliary circuit as well as the usual working circuit should be capable of complete disconnection outside of the building so that in the event of fire, water could be used with safety.

NOVEL CAR TICKETS AT ASBURY PARK.

THE roadbed of the electric road between Ocean Grove and Belmar is completed, but legal troubles prevent the company from operating its cars. On Aug. 18, Founder Bradley ran his private car over the line, using a team of horses for the motive power.

The car was crowded for several trips, but, instead of paying for their ride in money, everyone who rode, including the driver and conductor, was obliged to purchase a copy of the *War Cry*, the official organ of the Salvation Army. The papers were accepted as tickets. Founder Bradley is in hearty sympathy with the Salvationists and adopted this novel scheme to advertise the meetings of the army taking place the following Sunday.

MEETING OF THE ENGLISH TRAMWAYS INSTITUTE.

THE annual meeting of the Tramways Institute of Great Britain and Ireland was recently held in London. Mr. W. J. Carruthers-Wain, who presided, said that he regretted the diminution in the earnings of tramways, whilst at the same time the number of passengers carried by the tramways considerably increased; the increase being from 565,000,000 in 1891 to 581,000,000 in 1892. He also regretted that only 38 miles of electric tramway had been constructed in England since 1883, whilst in the United States, where the industry only commenced in 1887, there were now 3,582 miles of electric tramways, and 5,851 cars, carrying 250,000,000 passengers annually.

Mr. L. Epstein made some remarks concerning the working of the electric cars in Birmingham, which are fitted with the Epstein accumulator. He said that there were six cars in regular operation, and 12 sets of accumulators in use. The first sets were supplied in December last, and in January and February, owing to the falls of snow, and the difficult conditions of the road, it was found that a power of 33 i. h. p. was required to propel a car up a gradient of 1 in 25. The 12 sets of cells had worked satisfactorily during the past six months, and during that period it had not been necessary to repair or replace any of the plates, the total number of which was 10,000. This implied in mileage that each set had performed about 6,000 miles, or 72,000 all together. The accumulators had worked highly satisfactorily, and there had been no more irregularities in the service than obtained with the steam and cable cars used in the same town and by the same company. He drew a comparison between the initial cost of installation of the overhead trolley system and conduit system, and the storage battery method. The cost for one mile of line on the trolley method was £4,000 a mile, and the conduit system cost about £6,000 a mile; whereas with the accumulator system, with 24 cars performing a five minutes' service on a line six miles long, the expenditure would be £12,000 as compared with £24,000 for the trolley and £36,000 for the conduit system on a six mile track. These figures concerned only the cost of accumulators on the one hand and the putting up of the trolley wires on the other, and the laying down of the conduit system; but they did not include the other electrical equipment, which was common to each system. The cells in use on the Birmingham cars, were maintained at the rate of 1½d. per car mile, and Mr. Epstein said that considerably less than the mileage of 6,000 per set (of the 12 sets) was sufficient to repay his company the cost of maintenance.

Mr. E. Freund, in a paper dealing with the electric lighting of omnibuses, described the Bristol battery, which is now used for that purpose on some of the 'buses of the London General Omnibus Company. The batteries are charged during the day in a wooden structure near the Victoria railway station, the current being obtained from the mains of the Westminster Electric Supply Corporation. The only difficulties that had been encountered had been caused by the omnibus conductors short-circuiting the batteries. It was estimated that with 200 omnibuses fitted with one lamp of six c. p. placed under the roof, the annual cost of lighting would amount to 47s. 6d. per omnibus.

EFFECTS OF ELECTRIC CARS ON TRAVEL IN OTTAWA, CAN.

AN interesting idea of the effect of the electric railway on the Ottawa hackmen can be obtained from the records of the books at the police office which contain the names of those to whom licenses have been granted. In 1890, the number of licensed hackmen reached the high water mark, amounting to 195. In 1892, the number fell to 127 and up to the first of July, this year, but 90 licenses were applied for. Last year only about 20 licenses were granted after July 1st, so the total figures for this year will doubtless fall short by between 15 and 25 of last year's figures. The hackmen say that the electric railway has very materially injured their business. Not infrequently a hackman will remain at his stand all day without a single "fare." For many of the cabmen Sunday is now one of the best days. On that day no cars are running, and a large number of people can take a hack for a drive out to Beechwood or to some other resort at a greater or less distance from the city. For this reason the bulk of the cabmen are opposed to Sunday cars, as this would materially interfere with the business done on this day by the cabmen. "It is surprising," said one hackman, "the number of people who use the cars in preference to the cabs. Formerly when a train came in at the station there would be a large number of "fares," but now the big majority of passengers jump on the electric car and go home in that way." In this, as in everything else, however, things will eventually find their level, and every trade and calling must adjust itself to changing conditions and circumstances. One after another of the old familiar faces are missed from the stands as one after another of the hackmen decide to embark in some more remunerative business. But what is to the disadvantage of the hackman is to the advantage of the public, for the price of one cab fare will pay for half a dozen rides on the electric railway, and besides thousands of people can afford to ride on the cars who could not afford to pay cab fares."

The revolution worked by the electric railway in the mode of travel in Ottawa, is seen also in the great reduction of the number of horses in the city. The reduction in the number of hackmen alone would lessen the number of horses by from two to three hundred, and to these will be added the cars employed on the street railway that will soon be retired in favor of electric cars. But this is by no means all. Scores of families who formerly were almost obliged to keep a horse to enable the ladies of the house and oftentimes the men also to get about the city, find now that they can dispense with them, as the electric cars give speedy, easy and cheap access to nearly all parts of the city. This is a boon greater than some people imagine, for to many of these people the cost and maintenance of a horse and conveyance was a burden they could ill afford. The exact amount of the reduction in the number of horses cannot easily be ascertained, but the waterworks officials, who are in the best position to know, say that it totals a great many hundreds. But in this, as in the other case, the loss in one way is more than made up in another, and the electric railway is the friend of the people. Not only does it enable many families who could ill afford to keep a horse to dispense with that costly luxury, but it enables thousands to reach any part of the city they desire at a cost within reach of even the poorest.

A FIERCE FIGHT FOR AN ELECTRIC RAILWAY CROSSING AT NORTH ABINGTON, MASS.

THERE have been several severe struggles between steam and electric roads as to the right of crossing, but the most furious fight is that which occurred on August 17, at North Abington, Mass., between the townspeople and the train men sent in car loads by the New York, New Haven & Hartford Railroad Company to prevent the Rockland and Abington Street Railway from crossing the steam railroad tracks at that point. During the whole afternoon hard fighting went on, in which a dozen men were badly hurt and great damage was done to property. At last the State Police were sent to the scene, and succeeded in quelling the riot; and Judge Bond of the Superior Court issued an injunction restraining the N. Y., N. H. & H. Co. from delaying the operations of the electric railway company. The steam road thereupon withdrew its forces, and the townsfolk settled down to reglazing their windows and plastering their wounds. It is a disgrace that such scenes occur. The respective rights of steam and street railways should be promptly determined by the legislature, especially in Massachusetts where the question is very much alive at the present time.

FRANKLIN'S ELECTRIC LIGHT.

THE following item has been going the rounds of the papers, but the State Department informs us that it knows nothing about the matter:—"The Department of State has just received from Mr. B. F. Stevens of the United States Dispatch Agency at London, an account of historical electric apparatus once owned by Franklin, which he has recently unearthed in that city. Among other things, Mr. Stevens says, he has found that Franklin, during his last sojourn in England, made an electric light, and that he could produce from it with his primitive appliances sufficient electric light to read by.

The lamp is in a good state of preservation, and has recently been tested by the owner, a gentleman residing near London, who finds that it works as satisfactorily now as when Franklin himself experimented with it. It is a curiosity of great value and importance in illustrating the history of electric lighting. It is by no means the arc light or the incandescent lamp of modern times. Its principle, however, is that of the arc light without carbon points, this device—which was invented by Sir Humphrey Davy in 1818—first demonstrating the practicability of electric lighting. The total length of the cylinder, within which the light is produced, is about 12 inches and the diameter 3 inches. Each end is provided with attachments for connecting it with the positive and negative poles of the machine, which, it should be remembered, was the only means of generating electricity with which men were then familiar.

The electric light in this rude but ingenious device was produced by the leaping of the intercepted current from the ball to the metallic point. The ends of the tube are partly closed, undoubtedly for the same reason that the globes of the arc light are closed at present (*sic*), and the light given off is brilliant and steady.

The machine with which Franklin generated the electricity for this novel experiment is turned by a crank, grindstone like, and was the most powerful and complete in construction of any electrical machine of that day. This crank turns a ponderous cylinder of glass, which is rubbed by brushes with silk covers. These brushes convey the electricity collected from the cylinder to the positive and negative conductors, supported on large glass pillars, where it can be used for purposes of experiment. The machine is stanchly built, and is capable of producing a spark 12 or 15 inches long. While simple in its construction, it could hardly be improved upon by our wisest electricians. It is especially adapted for the advanced experiments of various kinds which Franklin was engaged with at that period of his life."

FIRE IN CENTRAL STATIONS AND THE QUESTION OF INSURANCE.[1]

BY WILLIAM BROPHY.

I DO not propose at this time to treat the subject of insurance in general, but as it applies to your own particular line of business. I need not detail to you gentlemen the necessary steps to pursue to organize an Electric Light Company, and the serious difficulties that often present themselves to those who attempt to secure the necessary capital for such enterprises, to say nothing of the task of paying a satisfactory dividend on the investment when secured. I am quite well aware that certain honorable legislators have labored long and hard to enable towns and cities to enter into the business of municipal lighting and thus relieve themselves of the unjust tax they would have people believe is being levied on them, necessary to pay the enormous (?) dividends they claim you receive, many of them knowing that a fraction of the same would be very acceptable to most of you.

But while honorable mayors will descend to the level of raising false issues of this kind, to enable them to reach the goal of their political ambition, while members of the great and general court will pass acts and resolves to enable cities and towns to provide nurseries, misnamed electric lighting plants, in which to spawn the followers of cheap ward politicians, and at the same time provide a bottomless pit into which a large share of the town and municipal taxes can be thrown without exciting the suspicions of the dear people who pay them, so long will you be held up as bloated capitalists and oppressors of the masses.

Reliable insurance against losses by fire is as necessary as capital, and in fact it is one of the prime factors in securing it; for very few capitalists would be willing to advance funds unless the burnable portion of the property was well covered by insurance placed in companies of unquestionable standing.

As this is as necessary to any company and must be obtained by nearly all, what is the best course to pursue to secure the best and at the least cost, and why it is so difficult to do so, are questions I propose to answer to the best of my ability; and I hope my conclusions will commend themselves to your better judgment as they are the result of daily experience in and observation of electric lighting plants, and consultations with those engaged in the electric lighting business, many of whom are paying dearly for past mistakes due to faulty construction, undesirable neighbors, little or no protection of their own or that usually provided by municipal authorities.

In the early days of the electric lighting business, many of those who planned or projected an electric lighting plant seemed to totally disregard all the well-known principles of mechanical engineering, while the architectural designs most readily adopted were those that were least adapted to economy of labor or space, and most likely to invite incipient fire and ultimate total destruction; while the idea of providing a single appliance for promptly extinguishing fires was never thought of.

In most cases then, and too many at the present time, total reliance was placed in the tender care and forbearance of Divine Providence, and numerous insurance policies were written at an excessive rate of premium, and for small amounts by reputable companies who were willing to gamble in this way, or written at low rates by that species of animal, the "wildcat" insurance company, who—like their feline namesakes—take all they can get and give nothing in return and evade pursuit quite as readily when an attempt is made to collect the sum named in their policies.

With the condition of things above described, it is not to be wondered at that fires have occurred with more or less frequency in this class of property, most of which might be ranked as extra-hazardous at first sight, while I regret to say a few which might be ranked fair to very good have been totally destroyed.

It need not be wondered at that wooden shells on light frames sheathed with pine or white wood at sides and ceilings, leaving concealed spaces with boilers poorly set, and iron smoke flues touching or dangerously near wood that is being slowly carbonized, rendering it still more inflammable; with iron stacks extending through floors, ceilings and roofs, without sufficient space intervening (a striking object lesson in the dangers attending this arrangement was given a short time since on the World's Fair Grounds, when to the total destruction of the building was added a fearful loss of life); grease allowed to accumulate on wooden floors until they are completely saturated, rendering them fit food for the flames; with attic and basements filled with miscellaneous truck, much of which is useless, but the storage of which is hazardous, should burn, but the wonder is that they do not burn oftener. It is unfortunate that fairly good to excellent electric light stations should take fire and burn down or be badly damaged even while men are on duty therein. But it is exasperating to think that by slight changes in construction, additional fire protection, the exercise of more care or more knowledge of and experience in the use of the appliance provided, they might be prevented.

I will now take up in detail a few of the fires that have come under my observation, giving the causes, and how they might have been prevented.

First comes the United States Station at Providence, R. I. This building was not originally built for the business of electric lighting, and a portion of it was occupied by other tenants. Dynamos and engines were on the same floor. This floor was cement, but oil had been allowed to accumulate thereon to such an extent that several barrels of saw-dust were spread over its entire surface to absorb the grease and filth. You may smile, and think that the man who did this should be sent to some institution for the care of feeble-minded youth, but I fear there are those still engaged in the business who are as worthy objects of the fostering care of such an institution as he, if the condition of the property under their charge is an index of their mental capacity.

There were but two men on duty; one in the dynamo-room and the other in the boiler-room; as might be expected in a station where such conditions could exist, discipline and order were unknown quantities, as was any sense of responsibility on the part of the employees, as the results will show. The man on duty trimmed the pilot lamp, and did, as he often had before, threw the hot carbons on the floor, not thinking for a moment of the oil saturated saw-dust. He then sat down calmly and enjoyed the sleep he should have secured when not on duty. The combination of hot carbons and oil-soaked saw-dust soon resulted in a little blaze, easily extinguished if seen in time, but the guardian of the room was oblivious to all his surroundings until the little blaze fanned by the moving belts became a roaring fire, the smoke from which entering his lungs finally awoke him, but in his half-dazed condition, he was in no sense able to cope with the fire, or even make his escape. The fireman was cleaning out the ashpits and could not know what was going on in the dynamo-room, but he either discovered the fire or was attracted by the cries of the other man, as it was afterward found that burning oil from one of the tin lubricators poured down over him, causing his death some hours after. He never uttered a rational sentence after the accident, while the other man was found dead in the dynamo-room.

This fire may be laid to the incompetency of the superintendent and the lack of responsibility induced by his example in the other employees.

I have given you the true cause of this fire, not the one given by the majority of a self-constituted committee of three, who made a so-called investigation, two of whom decided it was caused by an explosion of coal gas; and the third, a so-called electrician, who insisted that the room was so filled or charged by positive and negative electricity, that discharges like lightning took place and caused this fire to spread with lightning-like rapidity.

From the actions of most of the insurance companies at the present time, it is fair to presume that most of them accept the conclusions of this quack as the true cause of all fires in electric light plants, and that it is beyond the power of mortal man to foresee or prevent them.

Next is the fire in the Edison station at Brockton. This fire originated in one of the feeder equalizers, the resistance coils of which being enclosed in a wooden frame, overheated and ignited the same and from there it communicated to the wooden roof. The cause of the spread of this fire was, as in the former case, due to the incompetency of the superintendent resulting in such a lack of discipline that the man in charge of the dynamo room could go out and lean over the fence long enough to permit the fire to get far beyond his control before he discovered it, had he anything to control it with, well knowing that no watchful eye would be likely to discover his delinquency.

Next was the fire at the Edison station at Head Place, Boston. This, as many of you know, is a fire-proof building. The walls are brick, floors brick resting on and between iron beams. The roof is wood, resting on one of these floors, as it was originally intended to carry the building higher. The wooden roof is covered with tar and gravel. The bare brick walls of the dynamo room not suiting the æsthetic tastes of the superintendent, he resorted to a practice very much in vogue at that time, and covered both walls and ceiling with wood, also covering the feeder equalizers with the same material. A short circuit in one of the feeders resulted in overheating the coils of the equalizers, fire communicated to the wood, worked up behind the sheathing and ceiling and had gained such headway when discovered, as to be beyond control of the men on duty, owing in a measure to lack of organization among them for such emergencies, as there was fire hose attached to standpipes in the room. The fire did not get beyond the dynamo room, and while the building was practically uninjured, the contents of this room were ruined.

This fire was due to the introduction of unnecessary and useless material into a fireproof building. Its rapid spread when discovered, according to the story of the men, would tend to strengthen the theory of the Providence crank in the minds of the insurance men, while in point of fact its progress might not have been rapid from the start until it was discovered.

Then comes the fire at the station at Narragansett Pier. A conspicuous example of what a station should not be, this building is of wood, two stories high, with one story frame boiler house. The general style of the building is the same as that prevailing in seaside dwellings, with the usual filagree and gingerbread work.

1. A paper read before the Massachusetts Electric Light Association.

The lower story was sheathed at sides and ceiling. The fire was caused by the negligence of one of those superintendents who never can do to-day what can be done to-morrow or next day. In the angle formed by the boiler house and the main building a large heap of rubbish was allowed to accumulate, consisting of large quantities of oily waste, broken packing boxes, straw, empty oil barrels, etc. A spark from a passing locomotive on the railroad track nearby probably ignited this inflammable material one Sunday morning, when there was but one man present. It communicated to the building and before it was discovered attained such headway that before it was under control it totally destroyed the boiler room and the roof and upper portion of the main building.

I visited this plant a short time before this fire, and pointed out the danger from this eyesore, but at that time the companies with which I was connected had no insurance on the plant, and my suggestions were advisory rather than mandatory. But, unfortunately, it was insured by them at the time of the fire, although I did not know it until then.

For protection a two inch pipe was run about 1,000 feet from the street main. This supplied the water for boilers. A 1¼ inch tee was put on the end of this pipe and two 2¼ inch hose outlets were attached thereto. A fine piece of hydraulic engineering, you can all see. That such an arrangement proved very inadequate in time of need goes without saying, and with the delay in discovering the fire, giving the alarm, and the necessary delay in getting the apparatus of a volunteer fire department to the scene and in operation, the wonder is that the total destruction of the property did not result.

Next comes the burning of the station at St. George, Staten Island. The main building was of brick, one story high, containing high speed engines, dynamos, etc. A frame building formerly used as a club house was purchased and moved up to the original building. The first floor of this building contained the boilers and a large Corliss engine, while the second floor contained that undesirable adjunct—a workshop. Steps had been taken to equip this portion with automatic sprinklers, but they were not installed. The fire originated in this place. It was discovered by people on the street and an attempt was made to extinguish it with the hose on the premises, connected with the waterworks, but the water was shut off. Hose was then attached to the boiler pump, but the fire had gained such headway that the capacity of this pump was not sufficient to cope with it. The result here was the total destruction of the building and contents.

The primary cause of the fire was poor construction, and the total loss was due to inadequate protection—showing conclusively that one source of water supply is not sufficient in all cases for the proper protection of property from destruction by fire.

Next in order comes one near home—the Ferdinand street station of the Boston Electric Light Company. The construction of this building in the main was good, but it had some objectionable features. The building was three stories in height, brick walls, wooden floors, joist rafter construction, flat roof, open stairways and elevator; but the crowning defect was the wooden sheathing on the sides and ceiling of the dynamo room, which gave the fire an opportunity to get in its work unobserved for no one knows how long. Small hose attached to standpipes and supplied from the city mains was located on each floor and ought to have been sufficient to control a small fire if promptly brought into use. Two men were supposed to be on duty in the dynamo room, which was situated on the second floor, but from the fact that the engineer on duty on the floor below saw the reflection of the light of the fire on the buildings on the opposite side of the street sometime before he was made aware of its location, it would seem that they must have been in a state of somnolence, or were inhaling the bracing air of a cold clear winter night. One of them rushed down into the engine room—crying, "Shut down, the building is on fire." Instead of shutting down, the engineer took the hose at the foot of the stairs, turned on the water and attempted to ascend and attack the fire. But it gained such headway that he and his companion could not reach the head of the stairs, and while one left the building, the other went to look after the boilers, leaving the engines to run until shut down by the fire department.

The cause of this fire, as at first given by the men supposed to be in the room, would seem to be electrical, as one of them at least thought it started at the ceiling near the switchboard, but if that were true, it must have made extraordinary progress to burn so fiercely at the stairway some fifty feet from this point, in a few seconds' time. If this were so, the theories advanced by the before-mentioned crank and by other well-meaning people that the presence of ozone in a dynamo room is sufficient to account for the rapid spread of fire therein, must be heeded. But just here comes in the hard but reliable rule of common sense, which prompts us to seek for the true cause. An examination of the premises showed conclusively, first that the fire must have started near the head of the stairs, probably in a water-closet located there. A lighted match, after having done duty in igniting a cigar or tobacco in a pipe, thrown down among the waste paper that usually litters the floors of such places; or the lighted stub of the cigar or hot ashes from a pipe alighting in the same place, was more likely to be the true cause of this fire, and the possible and probable absence of the eye of a watchful attendant the cause of its spread, unless it caught between walls, floors or ceiling where it could not be discovered. The origin of this fire is somewhat shrouded in mystery, but the reason of its spread was no doubt due to the causes described above and improper construction.

We next have the destruction of two stations at Buffalo, within a few months of each other. The first was meant to be nearly fireproof, but as the business increased beyond the expectations of its owners, additions were made at different times that did not add to its safety. The dynamo and engine-room was unduly crowded. This fire is supposed to have originated in a lightning arrester or a loose connection, both of which were located on the switchboard, the wires leading from which were covered with highly inflammable material, and over which the flames spread with great rapidity, and up into the second story and the material stored there. Nothing was provided here for fire extinguishing purposes, and of course, no effort made to stay the progress of the flames until the arrival of the fire department. Owing to the crowded condition it was not a model of cleanliness and the oil-soaked floors added fuel to the flames. The loss was heavy.

Then came the largest and best station owned by this company. This might be called an excellent risk, but as in many others had some defects not discernible to the unpracticed eye, but after the fire they were manifest to any casual observer.

First and worst was an unoccupied space under the floor of the dynamo-room, access to which could be had at only one point, the average distance from the ground to under side of floor being about three feet. In this space were all the wires from dynamos to switchboard and tower. They were all lead-covered and but recently put in, and it is not probable that they were the cause of the fire. Masons were engaged on foundations for an additional engine, and that effective combination—a mason's tender, match and pipe, and a quiet smoke in a secluded spot safe from observation, was the probable cause of this fire. It occurred early in the evening when all the men were on duty, and was manifest to the sense of smell for some time before it was discovered. A trap in the floor being raised, the flames rolled up from beneath; and although hose and playpipes were located at several points in the room and connected to a powerful steam pump, no effort was made to use them. The fire under these circumstances made rapid progress, and the roof being supported on light timbers strenghtened by iron trusses which quickly expanded, letting the whole down on the machinery, caused a total loss thereon.

This space under the floor was a fatal defect, and a fire in the same was very difficult to handle, even by trained fire departments. The fire apparatus was of little use, as the men were not organized or trained in its use, showing conclusively the necessity for fire drills when such apparatus is provided.

The last, and the one that has had the effect of demoralizing insurance companies and rates on this class of property, is the fire at and total destruction of the station of the Suburban Electric Light Company, at Elizabeth, N. J.

This was what might be called a model plant, even from an insurance point of view, and was kept in an excellent condition of cleanliness and order. It was built of brick, two stories high, mill constructed, with flat roof. The lower story or basement contained the foundations for the engines and shafting. The boiler house was separated by a solid brick wall extending above the roof. There were also a few supplies, but very few that could be called inflammable, in this basement. Power was furnished by two large Corliss engines, the fly wheels of which extended through the floor and into this basement. Within 10 feet of one of these wheels was a barrel of oil on a wooden box.

Sometime after 11 o'clock a strong smell of burning oil pervaded the dynamo-room. The two men on duty proceeded at once to examine all the bearings, which were numerous, and this consumed considerable time. No hot bearings being found they proceeded to the basement and found flames streaming out of the barrel. They at once returned to the dynamo-room and attempted to shut down, but the action of the fly wheel carried the flames up so that it was impossible to reach the throttle. There was nothing in the form of fire pumps, hose connections and hose on the premises, and a fire once under headway had full sway. The loss on the main building and contents was nearly total to the owners and total to the insurance companies.

I have given you these rather minute details for the purpose of calling your attention to the probable causes of the several fires and how they might have been prevented.

With the present feeling prevailing among insurance companies, combines and associations, I fear the time is distant when insurance can be secured on as favorable terms on property of this class as on others equally as hazardous.

In all fairness, I must say that the blame for this state of affairs does not rest wholly with the above-named associations. A good share of it must be borne by some of those engaged in the electric lighting business. To be frank with you, gentlemen, I must say that but very few of the thousands of electric light men have any conception of the value of excellent construction or adequate protection of the different grades of electric stations.

Let me picture to you the model fireproof building, those of slow burning construction, and how to improve existing plants that cannot be classed with either.

The owners of a building with brick walls and floors, with metal or other fireproof roof; iron window frames and sash; standard metal doors; no oils of any kind—except what is necessary for daily use; and no storeroom or workshop contained therein; unexposed by other buildings; boilers if contained in the same building to be absolutely cut off by a solid brick wall; the necessary openings protected by standard fire doors; boilers well and safely set with ample space from floor to roof, need have little fear of its destruction by fire, or experience much difficulty in securing insurance and at low rates.

A station built of brick, one or two stories high, with brick floors and flat roof constructed of three-inch plank, tongued and grooved, covered with tar and gravel and the whole resting on wood or iron trusses or square timbers; and in every other respect like the one before described is nearly as good and ought to rate nearly as low.

Next, a brick building with heavy three or four inch plank; floors with a top covering of hard wood, the whole resting on heavy square timbers; roof of same as last type; boiler house same with exception of roof; boiler room in all cases to be cut off by fire wall as before described; window casings and frames of wood; doors the same, but where exposed by other buildings, more particularly those considered hazardous, windows should be provided with standard fire shutters. In all cases where buildings are more than one story high, stairways should be enclosed in brick and be constructed of iron with standard self-closing fire doors, in a fireproof building, such as first described, and enclosed in heavy plank in the two latter types. All weight bearing iron supports, such as columns and posts, should be covered with non-conducting material, where much inflammable material is stored or kept.

One of these three types of buildings is the only one that should be built from this time on. It is assumed that no inside finish such as lath and plaster or wood sheathing, leaving concealed spaces, is to enter into the construction of these buildings.

I have thus far described only the best types of electric light stations. What can be done, may be asked, to improve the vast number that are in existence, many of which cannot approach these in point of excellence?

My answer is that the very poorest class can be improved and made very much safer. First, take the brick stations, with pitched, hip, flat or mansard roof, with blind attic underneath. Rip this out at once; next, sheathing on the undersides of floor joist or rafters—rip it off. The same can be said of sheathing at the sides, if a hollow space is under it. The bare brick walls and enclosing boards of roof are the best finish. If a wood partition is all that separates boiler and dynamo-room, pull it down, and build it of brick, extending three feet above the roof. If the roof or ceiling of your boiler-room is too low, raise it up or build it of metal; and, if this cannot be done, equip it with automatic sprinklers. If your stack is of iron, have it well-protected where passing through wood floors and roof. A basement, second or third floor or attic, when used for supplies or general storage add greatly to the fire hazard and insurance rates, and should be banished from all stations when possible. Workshops ditto, or they should be equipped with automatic sprinklers. A basement or portion of first story containing lines of shafting seldom visited by anyone, and invariably left alone during the night run, should be sprinkled, for hot boxes alone have caused the loss of millions of manufacturing property.

In point of fact, many defects in construction, which must add to the fire hazard and increased rates of insurance, can be remedied by the introduction of this reliable device. A never failing supply of water should be furnished to make them effective at all times.

In addition to the sprinkler system, outside hydrants should be set, the number and location of which should be governed by the size of the building, the nature and location of the exposures. They, like the sprinklers, should have a never-failing supply of water either from public waterworks or a steam pump on the premises. A sufficient amount of hose, play pipes, etc., should be provided and ready for use at all times where a city fire department is not accessible. In addition to this, standpipes and hose should be provided in sufficient number in the interior of the building.

I have thus far only indicated the points where in my judgment it is imperatively necessary to install automatic sprinklers; but I believe those engaged in the electric business will never enjoy that immunity from loss by fire, or the abnormally low rates of insurance enjoyed by the manufacturers insured in the Factory Mutuals until they follow in their foot-steps, by building their stations in the best possible manner, and equipping them with the best known devices for protection against fire.

Each of the manufacturing establishments insured in the New England Mutuals is so equipped as to be independent of local fire departments for protection against fire. As a result the average cost to them for insurance is from ⅛ to ⅕ of one per cent.

One year ago ten of these companies commenced to write insurance on electric light and electric railway property. Owing to the fact that many of these establishments operate continuously, the same degree of protection was not called for as in the case of all other risks insured by them. Small hose on each floor with an abundance of water pails kept full of water, in some portions of the building; outside hydrants and hose when an efficient fire department was not available; general order and cleanliness insisted on, and unless the construction was not up to a certain medium standard, the risk was declined. In less than 11 months the losses sustained exceeded the premiums received by more than 50 per cent., showing conclusively that reliance on apparatus of this kind, in the hands of the men employed, to cope successfully with fires, is like leaning on a broken reed, and worse than nothing.

I will give you one notable instance of the utter demoralization of employees. In the dynamo-room of the Elk Street Station of the Buffalo General Electric Company were six outlets for hose, with hose and pipes on swinging racks ready for instant use. The fire occurred early in the evening, when the largest number of men was on duty, yet not one of these lines of hose was disturbed, and no attempt was made to use them.

The last 11 months experience has demonstrated to these companies that the business of insuring electric light property at the same and in fact less average rate than that charged for standard manufacturing property, is in the first place not profitable, in the next—unjust to the owners of the latter. For if they are to continue to pay to the former 60 to 90 per cent. dividends, it must be taken from the profits derived from the business of the latter.

Perhaps it would have been better had the companies continued to insure those risks that were equal in construction and equipment to standard manufacturing risks, but they are so few they are hardly worth considering.

Owing to this action of these companies, electric property is now practically placed on the prohibited list, and high insurance rates must prevail. For this, gentlemen, you have the remedy in your own hands, if you will only apply it.

More than 60 years ago it was impossible for those engaged in the manufacture of cotton, woolen and other textile goods to secure insurance against losses by fire at rates that they could afford to pay, so that the owners of such properties could not rely on the policy of insurance to re-imburse them in whole or in part in case of fire.

For this reason they were driven to first improve their property, so as to reduce the probability of destruction by fire, and next to provide the best devices for quickly extinguishing the same that could be procured at that time; and where necessary organized their employees into efficient fire companies, as well trained in this particular duty as any other. The next move was to mutually aid each other in case of actual loss by fire, by organizing the first of the New England Manufacturers Mutual Insurance Companies. The officers and directors were owners or managers of some one of the factories insured, and were thus familiar with this particular kind of property, knew where the fire hazards existed, and knew best how to reduce the same where possible. Each policy holder became a member of the company, and had a voice in its management, through the board of directors.

In addition to the then existing high rate of premium paid in cash, they obligated themselves to pay five times that amount as a contingent liability in case the cash premiums were not sufficient to pay all losses that might occur and other necessary expeses.

So successful was this pioneer in Mutual Fire Insurance, that there are now 23 such companies in successful operation, and they have over $650,000,000 at risk. The average net cost of this insurance on property that at one time was on the prohibited list, is about $\frac{1}{16}$ of one per cent. From the time of the organization of the first company to the present, they have never failed to return a port on of the premium in the form of a cash dividend after they once began; have never made an assessment on their policyholders, thus showing that the contingent liability exists in name only.

With this example before them, why cannot those engaged in the electric business adopt the same plan and carry it to a successful issue?

The Industrial Mutual Insurance Company, in connection with nine others has been writing insurance on electric property since August, 1892. Owing to the losses sustained by the burning of the stations of the Buffalo General Electric Company and the Suburban Electric Light Company of Elizabeth, N. J., and to the fact that the directors are manufacturers and unacquainted with the business of electric lighting and electric railways, they have decided to discontinue writing insurance of this kind. The action of these companies would have been quite different, no doubt, had the electric interests been represented on the different boards of directors.

The Industrial Mutual Insurance Company proposes to continue this business alone, providing insurance to the amount of $50,000,000 can be secured, to be written at *one time*. The plan has been submitted to the managers of the General Electric Company, and many others prominent in electric light business, and has been heartily endorsed by them. Insurance already applied for, towards the $50,000,000 called for, amounts to nearly $20,000,000.

When the amount ($50,000,000) is secured, policies will be written, and the company will have ample means with which to meet any losses that may occur.

It will have cash assets $594,058; its contingent liability $2,800,-621; its total security will be $3,394,679. Its receipts from interest will be over $22,000, which will pay its expenses. It will have $56,244,392 at risk.

It is the purpose of the company to secure all the desirable electric property it can, which will increase its dividends and reduce the proportionate expenses, and at the same time reduce the net cost of insurance.

I cannot in this paper give you, gentlemen, all the details of this plan of insurance you might require, and you might not remember them if I did; but any one of you desiring more detailed information on the subject, can by addressing me receive the same promptly and fully. In connection with others, I have given this subject the most serious consideration for a long time, and I believe it to be the only way in which those engaged in the electric business can insure their property at cost.

LITERATURE.

The Law of Incorporated Companies Operating under Municipal Franchises. . . . Preceded by a Suggestive Discussion of the Economic Principles Involved in the Operation, Control and Service of such Companies. By Allen Ripley Foote. Charles E. Everett, A. M., LL.B., Editing Attorney, with a resident attorney in each state as co-editor. 3 vols. 8vo pp. lxxix 1288–2930. *Cincinnati*, Robert Clarke & Co., 1892. Price $15.00.

"I ask the public to read this work because it answers a purpose not fulfilled by any existing book, and it treats of subjects of vital importance to every citizen." These are the closing words of the preface of what we cannot but regard as one of the most important and valuable legal treatises which it has ever fallen to our lot to examine. The subject which the author has undertaken to discuss may be briefly stated to be the economic and legal relations of industrial corporations operating under municipal franchises, to the municipalities themselves, to the property owners and to the taxpayers. The work is designed to be of the broadest and most fundamental character, and seeks to elucidate and set forth the true economic principles which should control the organization, management and supervision of all public industrial corporations. Incidental to the general plan, it has been deemed necessary to investgate the fundamental natural principles and conditions governiing the relations of labor and property; the natural resources of industry; the modification of isolated natural conditions rendered necessary by association; the principles which should govern the ownership of municipal thoroughfares in order that the public may derive the maximum service therefrom; the essential character of industrial municipal monopolies; the character and advantages of industrial corporations for supplying municipal needs, and the urgent necessity of enlightened methods of state control, of all municipal, political and industrial corporations, to the end that the best services may be secured for the public welfare.

To control and regulate efficiently, without at the same time oppressively restricting the power of industrial corporations, is one of the most urgent, and confessedly one of the most perplexing, problems of the present day. The unprecedented growth and development of urban populations, stimulating and rendering imperatively necessary the multiplication of municipal advantages and conveniences of every kind compel the attention of the citizen to problems of the gravest importance; the solution of which, in some form, even though an obiously inadequate form, often admits of no postponement. The maxim of the author is, that in this, as in most of the affairs of the world, "the ideal good and the realized good are far apart," and that "real progress can only be made by causing the realized good to approach the ideal good." He therefore seeks to determine, by a series of logical deductions from the fundamental principles of justice and equity, wherein consists the ideal good, in respect to these matters, and then to exhibit comprehensively, in systematic order, the initial, progressive and present development of federal, state and municipal law, as found in constitutions, statutes and decisions, in order that these may be compared with true economic requirements.

An investigation of this kind, to be of practical utility, must obviously be comprehensive, exhaustive and thorough. It must fulfill these requirements, because it is only in this way that it is possible for future legislation to be so guided and directed as to enable it to correct the multifarious errors which have been committed in the past It is not too much to say in praise of the present work that the author has succeeded even beyond reasonable expectation in presenting a clear, comprehensive and logical exposition of the principles which are necessarily involved in the solution of the problem at issue. This done, he proceeds to a consideration of the question "How can the realized good be made to approach most nearly the ideal good?" The answer to this inquiry in its general aspect, cannot be better given than in the language of the author:

"The use of the ideal is to serve as a model. The practical thing to be done is to cause every change to tend as much as possible to secure a full realization of the ideal good. A statesman is one who fully understands the ideal, and has sufficient judgment to propose only such measures tending to a realization of the ideal as can be understood and appreciated by the people. A politician is one who is guided by no ideal or principle, and who proposes only such measures as will most easily catch the popular applause and carry him into or retain him in power. The statesman is an educator and a true prophet for the people. His efforts are always intended to conserve the public welfare. The politician is a tempter and a false prophet for the people. His efforts are always intended to contribute to party supremacy. *Statesmen, not politicians, must be depended upon to carry the measures necessary to place the control of municipal, political and industrial corporations where it should be, in the administrative policy of the state.* Statesmen cannot be bribed nor intimidated. They have intelligence and courage. They can be relied on to do right because it is right. Statesmen regard character, not property, as the most valuable acquisition of life. Character does not result from corrupt, prejudiced or ignorant actions. Statesmen always cause party success to serve public welfare."

Setting out with the basic assumption that municipal needs, such as water, gas, and electric service, must of necessity be supplied by some kind of a municipal monopoly, the author devotes much attention to the inquiry whether it is desirable that this monopoly shall be of a political or an industrial character. The service must be rendered either by the representatives of the people in the name and for the account of the people, or by industrial corporations in the name and for the account of their stock and bondholders. Which course shall be pursued is purely a question of public policy; the economic principle involved is that of serving the interests of every individual economically through the public service rendered. It is scarcely necessary, however, for the author to remind us that the beneficiaries of the political monopoly are politicians, and that their dependents are certain to work for the good of the party instead of the good of the public. "They regard property, instead of character, as the acquisition of supreme value. Their standard is false. They are guided by an ignorant self-interest. The result is an economic loss for the many who are taxed to pay for the services they render. Such legislation is not economic; it is anti-economic. Nothing"—says the author—"can be more paradoxical than the conduct of those who most loudly and most unintelligently oppose industrial monopolies, in which form services are rendered under the management of the most capable, while they advocate municipal, state and national monopolies, in which form services are rendered by the least capable."

The conclusions reached by the author may be summarized as follows:—All municipal needs should be supplied by the efforts of industrial corporations, as distinguished from political corporations; industrial corporations organized to supply perpetual municipal needs should have the exclusive right to supply such needs perpetually; all accounts should be honestly and correctly kept; economic thrift should be insisted upon in every department, and charges for the use of the services should bear a fixed relation to the necessary cost of production; the character of the need to be supplied, not the character of the method of supplying it, should determine the franchise specifications of the service to be rendered. Says the author:

"Perfect franchises will grant the right to use municipal thoroughfares in special ways for the purpose of supplying municipal needs. They will be an exact equivalent to a perfect title to real estate, and will conform fully with the conditions that secure economic value to all property. They will be in accord with all ethical and economic laws that proclaim and establish the dignity and freedom of labor. They will guarantee the unobstructed, exclusive and perpetual right to supply a service, subject only to such use and control as shall best serve the public welfare. By guaranteeing such franchises to industrial corporations the state will secure the healthfulness of every municipality as surely as a person secures the healthfulness of his body by obtaining an abundant supply of pure air, water and food."

Reviewing the whole body of federal, state and municipal legislation, as set forth in the copious digest which occupies the larger portion of the work, the conclusion is reached that the statutes which have been enacted and the franchises which have been granted by way of fulfillment of the political trust confided in representatives to secure the public good, have illogically attempted to provide a perpetual supply for a perpetual need, by limiting the right to supply service to a comparatively brief term of years; by permitting others to build on the same ground through failing to make the right exclusive; by specifying particular methods to be used, and thus compelling duplications of corporations and plants in order to bring new methods into use; and by taxing the means through which the needs of municipalities are supplied, thus curtailing advantages that are aids to industry, ministers to comfort and promotors of the values of all public and private property.

"That state which first succeeds in intelligently changing its

system, or want of system, of organizing and controlling municipal, political and industrial corporations, by adopting a system in conformity with the outlines here given, will soonest establish the conditions that will induce the greatest degree of prosperity and well-being for its municipalities and their inhabitants. So conditioned and so controlled municipal industrial monopolies will become the friends and servants of the people, and will render the best services of which they are capable at the lowest obtainable cost to users."

It is difficult to resist the temptation to present many more abstracts from this most admirable work. Apparently dry and uninteresting in the abstract, as the subject is, the author, by his concise, clear and pointed style, his perfect control over his material, and his comprehensive grasp of the legal and ethical principles involved in the discussion, has produced a work which is scarcely less attractive to the general reader than is a masterpiece of fiction. The lay reader, as well as the lawyer, the jurist and the publicist, may consult its pages with pleasure and profit. We shall be much surprised if its publication does not mark the beginning of a new era in the history of industrial and corporate legislati n, and a point of departure towards the ideal state of affairs so enchantingly pictured by the author as among the possibilities, we can scarcely say, the probabilities, of the future. The labor of the author and his collaborators has been enormous; we trust that their reward in character if not in property may at least in some small degree, be commensurate therewith.

The publishers deserve great praise for the attractive manner in which their part of the work has been performed. The paper and binding are excellent, the type clear and open, and the matter conveniently and attractively arranged.

Telephonie Pratique. By L. Montillot. *Paris*, 1893, A. Grelot. 495 pages, 6½ by 10 inches. 418 illustrations. Price, $3.

FOR those who have been brought up in the school of American telephony, where one type of apparatus may be said to run through the entire system from one end of the country to the other, the contents of the work before us describing the telephonic apparatus in actual use in France will be a revelation. Instead of a single type of transmitter and receiver generally employed in this country, we find dozens of both classes of instruments in use there, and the another has been at special pains to exclude all such apparatus that is not in actual operation. As an inspector in the Postal Telegraph Department, the author has had excellent facilities for obtaining his information. One of the objects of his work has been to enable the reader, and especially those engaged in telephony, to obtain an accurate knowledge of the apparatus described and to that end the illustrations are carried out and elucidate the most minute details. It would take us too far to enter into a discussion of the various types of apparatus described, but no one can go over the work before us without being impressed with the enormous number of changes which can be rung on the simple principles involved in telephony. The comparison of the efficiency of these various types of apparatus can, of course, be more precisely made by the results of actual experience, but we note that the author has in almost every instance given an illustration of the magnetic field produced by the magnets of the various types of receivers described, which throws some light on their proper efficiency. Besides the receiver and transmitter, the various accessory details, such as switchboards, subscriber's installations, etc., are described in great detail, and overhead line construction also receives its due share of attention. The author has also added a description of various types of batteries used in connection with telephone work in France, together with a number of useful hints for their most economical operation. And to afford a general view of the functions of the state in its relations to telephony, the reader will find a very good history of the legislature on this subject in France since 1879, and of the growth of the art.

The work being of a purely descriptive nature, leaves little room for criticism or comment. We notice, however, that the author is in error in stating the first Bell patent to be dated February 14 instead of March 7, 1876. Credit is also given to Edison for the introduction of the induction coil in telephony; Berliner is, of course, entitled to this distinction. The work has evidently been prepared with great care and is a valuable addition to the literature on the subject.

Electrical Distribution, Its Theory and Practice. Part I. By Martin Hamilton Kilgour. Part II. By H. Swan and C. H. W. Biggs. *London*, 1893. Biggs & Co. 424 pages. 5 by 7 inches. Illustrated. Cloth. Price, $3.60.

GIVEN a certain area to be supplied with current, whether for light or power, whether for stationery motors or for electric railways, the electrical engineer, as a rule, has the selection of more than one method of distribution and the economy of the system when completed will depend much upon the care and ability exercised in the selection of the best methods. In the work before us Mr. Kilgour has taken upon himself the task of considering the principles which govern the distribution of electric energy in general, and takes up a number of actual cases in a manner which shows very clearly the benefit to be derived from an intelligent study of such methods. In this way he treats of a large variety of conditions relative to feeders, distributing mains, etc., including in his calculations both the series and parallel system of distribution. Not the least valuable section is that relative to the design of electric railway feeders, which many electric railway manager in this country could read with advantage. Throughout his section Mr. Kilgour treats the subject in a manner which shows his thorough practical familiarity with it.

In Part II. Messrs. Swan and Biggs present to the reader a very well written and completely illustrated description of the various systems of underground distribution in vogue in England and on the continent of Europe, including the systems employing bare wire which appear to be meeting with considerable success in a number of cities abroad. The two parts taken together afford an excellent compendium on the subject.

The Electric Transmission of Intelligence and Other Advanced Primers. By Edwin J. Houston, A. M. *New York*, 1893. The W. J. Johnston Company, Ltd. 330 pages. 5 by 7 inches. Cloth. Price,

THE ELECTRICAL PRIMERS, which Prof. Houston brought out at the time of the Philadelphia electrical exhibition in 1884 met with such success that the author was induced to enlarge their scope somewhat, and the volume before us is the result. The subjects treated of include the various methods of telegraphy and telephony now in vogue and the description of a number of annunciators and alarms and of the Edison phonograph. Chapters are also devoted to electrolysis, including electrometallurgy, storage batteries, electrotherapeutics, electricity in warfare and other applications of electricity. The final chapter is a résumé of the whole, entitled "Primer of Primers," in which the author gives in brief pithy sentences the main principles underlying the various applications treated of in the preceding chapters. Prof. Houston's style is so lucid that the book will find very ready acceptance among beginners.

LEGAL NOTES.

AN INTERESTING DECISION AT DES MOINES AS TO POLES.

AT Des Moines, Ia., on Aug. 8, Judge Holmes handed down a voluminous decision in what is known as the telephone pole case, which is in substance as follows: The board of public works, acting under authority of an ordinance, ordered the telephone company to remove its poles from the gutters in the business portions of the city and set them back *inside the curb line.* Mr. Conrad Youngerman, believing the city had exceeded its powers in the premises, and there being several poles in front of property owned by himself, objected to the moving of the poles as ordered, and applied for an injunction to restrain the authorities from carrying the order into effect. The issues in controversy were exhaustively argued by eminent counsel on both sides and submitted to the court. Judge Holmes in a written opinion that filled 40 pages, announced his finding and denied the injunction. In passing upon the question of the construction of area walls and area ways extending into streets under the sidewalks, the court holds that property owners have no legal right to construct such walls and excavations, which it is claimed are merely permitted by sufferance and not because of any lawful rights.

MORE ELECTRIC RAILWAY LITIGATION IN NEW ENGLAND.

AT New Haven, Conn., on August 15, the U. S. deputy marshal served papers in a suit against the Winchester Avenue Railroad Company brought by the Thomson-Houston Electric Company, of Boston, through their attorneys, Betts, Atterbury, Hyde & Betts, for damages and profits for the use of apparatus alleged to be patented by the plaintiffs. The suit is returnable to the United States District Court on the September return day.

This is the fourth suit for alleged infringement of patents which has been brought against the defendants during the past four months. Similar suits in all cases have been brought against the Westinghouse Electric and Manufacturing Company of Pittsburgh, and this company will defend in all suits as the Winchester Avenue Railroad Company are using apparatus made by this company.

SPRAGUE HIGH DUTY ELECTRIC ELEVATOR.

THE high duty elevator, 400 feet speed, to be put in the Edison Electric Illuminating Company's station at Pearl and Elm streets, N. Y., is to be a Sprague-Pratt, furnished by the Sprague Electric Elevator Company.

SOCIETY AND CLUB NOTES.

A SEASIDE DINNER IN HONOR OF MESSRS. PREECE, SIEMENS AND JAMIESON.

A MOST delightful entertainment was given on Wednesday evening last, at the suggestion of Mr. John W. Mackay, by the officials of the Commercial Cable and Postal Telegraph Companies, in honor of Mr. W. H. Preece, Mr. Alex. Siemens and Prof. Jamieson, who have come to attend the International Electrical Congress at Chicago. The hosts and guests of the evening assembled in the office of Mr. George G. Ward, and thence proceeded by the Bay Ridge route to Manhattan Beach, where an excellent dinner was served in a private dining room, near the music and overlooking the sea. While no attempt was made at any formality, the dinner was followed by a little friendly speech-making and international badinage. Mr. Ward, who presided gracefully, gave as the toast of the evening the names of the three distinguished guests from over the water, and a fitting response was made by each. Mr. W. H. Baker, who faced Mr. Ward, spoke of the regret of Mr. Mackay at not being able, through his serious illness, to be with them that night, and conveyed to all Mr. Mackay's regards and good wishes. He also mentioned a recent interview, in which Mr. Mackay had expressed his earnest wish that, in spite of the serious business depression, no one in his telegraphic service should be dispensed with if there were any possibility of retaining the man. Mr. Mackay's health was drunk very enthusiastically. Brief speeches were made by Messrs. Harding, Sprague, Kennelly, Bottomley, Martin, and Fowler, and the interchange of joke and quiz and good story went on at a lively rate until the party had to break up in order to catch the last train from the Island. It was a happy thought to dine by the sounding sea, and still happier was the execution of the idea. But Mr. Ward always does clever things in a brilliant way, combining the best qualities of two nationalities—the one that bred him, and the one that he now belongs to. It was indeed an international occasion, with talk of old submarine cable days, of "new things" in American practice, and the growing unity between England and America. Reference was made to the curious fact that Mr. Preece always comes over here in times of depression, which proceed immediately to improve, and stay bettered until his absence from these shores is again too greatly prolonged.

The following were present: W. H. Preece, Alexander Siemens, Prof. A. Jamieson, J. Bottomley, A. E. Kennelly, Frank J. Sprague, Chas F. Cutler, G. A. Hamilton, T. C. Martin, G. M. Phelps, Dr. Geo. G. Ward, Jr., E. C. Platt, W. H. Baker, E. C. Bradley, F. W. Jones, Geo. Edward Harding (architect), Charles Cuttriss, General E. B. Fowler, Chas. E. Merritt, Geo. G. Ward.

Regrets were received from: T. A. Edison, E. H. Johnson, F. W. Roebling, Nikola Tesla, and J. Wetzler.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

BY request of the president, an informal meeting of the Institute will be held at the World's Fair Headquarters, Electricity Building, on Wednesday, August 23, 1893, at 8 o'clock p. m. This is intended to be strictly a social gathering, for the purpose of extending personal acquaintance between members, who may be present during the week of the International Electrical Congress, Aug. 21 to 26.

The rooms of the Institute are located in the south end of the gallery, and will be found a desirable resort for those who visit the Exposition.

THIRD CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION.

THE third convention of the young and vigorous Canadian Electrical Association has been arranged to be held in the Industrial Exhibition Association Buildings, Toronto, on September 12, 13 and 14, when president J. J. Wright and secretary C. H. Mortimer have provided an excellent programme as follows:

Tuesday, Sept. 12, 2 p. m.: President's Address. Secretary-Treasurer's Report. Report of Committees. General Business. Paper by Mr. Fred. C. Robertson, Toronto; Subject: "Some of the Causes of Interruption to Telegraph Circuits." Paper by Mr. A. C. McCallum, of Peterboro'; Subject: "Water Wheels."

Wednesday, Sept. 13, 10 a. m.: Nomination and Election of Officers, and selection of place of next meeting. Unfinished Business. Paper by Mr. L. B. McFarlane, of Montreal; Subject: "The History of the Telephone in Canada." Paper by Mr. E. B. Merrill, Toronto; Subject: "Electrical Education." Paper by Mr. John Langton, Toronto; "Subject: "Direct Connected Dynamos and Steam Engines." Paper by Mr. E. Carl Breithaupt, of Berlin, Ont.; Subject: "Electric Street Railways."

On Thursday the members and friends will take steamer to Queenston and will ride over and inspect the fine trolley road of the Niagara Falls Park and River Railway Company. They will also inspect the hydraulic operations on the American shore, take a sail in the "Maid of the Mist," lunch at the Cliff House, and dine on board the Toronto boat on the homeward trip.

PERSONAL.

MR. C. W. BURROUGHS has closed his connection with the Potsdam, N.Y., Electric Light Co., and removed to Auburn, N. Y., where he accepts the more lucrative position of general manager for the Thomson-Houston Electric Light and Power Company. Mr. Lucien Gray, who has been with Mr. Burroughs for some time, takes charge of the Potsdam plant.

PROF. R. MULLINEUX WALMSLEY, D. Sc., of Heriot Watt College, Edinburgh, is now in this country, and after a brief stay in New York and the South has proceeded to Chicago, to participate in the Electrical Congress.

MR. M. J. SULLIVAN.—The marriage is announced of Mr. M. J. Sullivan and Miss Frances Read, at Freeport, Ill., on August 15. The event is attended with the congratulations and good wishes of a host of friends.

MR. AARON SEELEY has resigned the position of superintendent of the Troy, N. Y., Telephone Co., which he has held for nearly fifteen years. He is succeeded by Mr. Francis A. Sims, formerly cashier of the company.

ON THE VARIATIONS OF THE "HALL EFFECT" IN SEVERAL METALS WITH CHANGES OF TEMPERATURE.

IN a paper on the above subject read before the American Academy of Arts and Sciences Messrs. A. L. Clough and E. H. Hall describe a series of experiments which they summarize as follows:

The Hall effect in copper and in phosphor-bronze is affected but little, if at all, by a rise of temperature from 20° to 360° C. The Hall effect was about one-half as great in the phosphor-bronze examined as in the copper, under like conditions.

The temperature coefficient of the electrical resistance of the phosphor-bronze appeared to be about 0.00045.

The Hall effect was observed in battery carbon. In nickel there is on the whole, in spite of certain marked differences, a strong resemblance between the temperature changes of magnetic permeability and the temperature changes of that "rotative power" upon which the Hall effect depends. It is doubtful whether an equally strong resemblance as to temperature changes could be made out between either of these properties and any other property of nickel. An equally broad statement cannot as yet be made concerning iron or steel, but the evidence obtained, so far as it goes, is on the whole in favor of such a proposition.

AN OPPOSITION TELEPHONE SYSTEM FOR DECATUR, ILL.

THE Decatur, Ill., *Review*, of August 11, says:—"For two days G. M. Scott, representative of the Harrison International Automatic Telephone Company, has been in the city negotiating with the new telephone company, composed of Decatur citizens. Arrangements are about concluded by which the Harrison Company will put in a plant in Decatur. They guarantee a first-class automatic telephone plant, that will give satisfactory service in every way. They also agree to protect the local company from any suits that may arise over patent infringements. The capital stock of the local company is $100,000. A large block of that will be taken by the Harrison Company.

TEST OF THE MARSHALL CONDENSER TELEPHONE.

A SPECIAL dispatch from Saratoga, N. Y., of August 14, says: "A test was made here last night of the new and greatly simplified telephone system, the recent invention of William Marshall of New York, in the presence of Mayor Gilroy, Henry Allen, E. J. Slatterley, Judge Dugro, Dr. Dumont, Charles Harmon, James English, and a number of other gentlemen. The test was made between Saratoga and Albany, a distance of nearly forty miles, over a single ordinary telegraph wire. The result was considered so satisfactory as to indicate a wonderful simplification of telephone service and a great cheapening of cost. It has been demonstrated that a conversation can be carried on by means of this system over on ordinary telegraph wire for a distance of 500 miles, which is as far as an ordinary telegraph message can be sent without repeating.

The system is the invention of Mr. Marshall. It is entirely novel in construction and principle. No magnet coil or diaphragm is used, it being dependent only for its acoustic interpretation of electric pulsations upon the alternate cohering and separation of sheets of ordinary tinfoil and paper arranged as a conductor. In the test the speakers' voices were reproduced with remarkable clearness, even a whisper being distinctly heard."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUGUST 1, 1893.

Accumulators :—

Box for Secondary Batteries, Electric Cells, etc., C. Theryc and A. Oblasser, Paris, France, 502,643. Filed Dec. 1, 1892.
Claim follows:
A battery tank or vessel provided with a continuous lining of agglomerated cellulose and hermetically closed by a cover of transparent celluloid.

Alarms and Signals :—

Magneto-Electric Machine, F. X. Hofbauer, Newark, N. J., 502,670. Filed Oct. 29, 1892.
For call-bell service and particularly adapted for domestic purposes.

Batteries, Primary :—

Galvanic Battery, E. H. Lyon, Brooklyn, N. Y., 502,405. Filed Sept. 26, 1892.
For preventing or diminishing local action.

Clocks :—

Electric Synchronizer for Clocks, H. S. Prentiss, Elizabeth, N. J., 502,381. Filed May 19, 1892.

Conductors, Conduits, and Insulators :—

Electric Cable, T. Guilleaume, Cologne, Germany, 502,358. Filed March 1, 1893.
A series of naked conductors occupying air spaces in a spirally grooved strip of non-conducting material occupies the centre of the cable.
Insulator, L McCarthy, Boston, Mass., 502,677. Filed Sept. 23, 1892.
For trolley wires.

Distribution :—

System of Electric Distribution, E. M. Bentley, Boston, Mass., 502,272. Filed May 8, 1893.
Raises the E. M. F. of one or more feeders of a group by supplying such feeder or feeders with an increased E. M. F. by interposing between them and the others of a group means for reducing the E. M. F. by the required amount.
Distribution of Alternating Electric Currents, W. Von Siemens, Berlin, Germany, 502,682. Filed July 16, 1892.
Claims 1 and 10 follow :
1. In a system of electrical distribution, the combination of a source of alternating currents, a plurality of independently located transformers, and an independent and separate supply circuit for each transformer from the source of energy.
10. The herein described method of distributing electrical energy, which consists in dividing the generated current between a number of transforming stations at which are located inductional transformers, and in varying automatically the current fed to the respective stations in proportion to the demand in the local distribution circuits from such stations.

Dynamos and Motors :—

Regulator, W. H. Elkins, Cambridge, Mass., 502,285. Filed January 3, 1893.
Specially adapted to series dynamos. Divides the field current into two portions, one passing through the entire winding, the other shunted around a portion of the winding; and provides means, responsive to changes in the main current, to vary the length of the shunted portion of the winding.
Electric Motor or Dynamo, S. Paugh, Indianapolis, Ind., 502,377. Filed Oct. 11, 1892.
Details of design and construction.
Dynamo-electric Machine or Motor, H. J. Ryan. Ithaca, N. Y., 502,384. Filed Sept. 7, 1892.
Claim 1 follows :
In a dynamo-electric generator or motor, balancing coils applied for the purpose of overcoming armature reactions, said coils being wound through holes in the pole pieces.

Electrolysis :—

Process of Desulphurizing Metallic Ores, H. H. Eames, Baltimore, Md., 502,431. Filed April 30, 1888.
Claim 1 follows :
The method of eliminating impurities and foreign substances from metallic ores, by placing them in an entirely closed vessel and subjecting them while so inclosed to the action of heat insufficient to fuse the ore and an electric current.

Heating :—

Electrical Heater, C. E. Jones, Elgin, Ill., 502,494. Filed August 1, 1891.
Claim 1 follows :
The combination of a body of iron or other metal possessing electrical conductivity, an insulated electric circuit coiled around two or more portions of said body in opposite directions and an electric generator connected with said circuit, whereby conflicting molecular action may be excited in said body and heat generated.

Lamps and Appurtenances :—

Carbon-Holder for Arc Lamps, S. Bergmann, New York, N. Y, 502,273. Filed October 22, 1892.
Electric Incandescent Lamp, P. Scharf, Vienna, Austria-Hungary, 502,322. Filed April 17, 1893.
Relates to the connections of the leading-in wires
Means for Protecting the Carbon Holders of Electric Arc Lamps, J. F. Mehren, Chicago, Ill., 502,465. Filed Oct. 6, 1892.
Employs a fusible conductor projecting below the carbon holder in such a position as to intercept the arc when the upper carbon is nearly consumed.
Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 502,471. Filed March 4, 1891.
For causing two arc lamps placed in series to burn successively.
Circuit-Controlling Mechanism for Arc Lamps, C. E. Scribner. Chicago, Ill., 502,535. Filed July 26, 1890.
Automatic means for switching the current from one lamp of a series, after its carbons are consumed, to the next lamp and so on.
Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 502,536. Filed March 12, 1891.
Provides circuits for arc lamps in groups, the members of the several groups being so arranged that one will burn after the other.
Socket for Incandescent Electric Lamps, W. C. Bryant, Bridgeport, Conn., 502,655 Filed May 6, 1893.
A wall socket.
Arc-Lamp Frame, A. Weber, Schenectady, N. Y., 502,687. Filed Sept. 8, 1892.

Measurement :—

Method of and Apparatus for Measuring Electricity, A. Aberg, Helsingfors, Finland, 502,451. Filed Jan 10, 1893.
Produces an atmosphere of saturated vapors around a Peltier conductor and conducts a portion of the current to be measured through the conductor in such a direction as to cause a cooling action and collects and measures the liquid condensed on the conductor.

Miscellaneous :—

Electrical Cash Register, Recorder and Indicator, L. Ehrlich, St. Louis, Mo., 502,287. Filed Sept. 28, 1889.
Electric Pole-Changer, C. E. Kells, Jr., New Orleans, La., 502,300. Filed Feb. 23, 1893.
For use with an electric motor.
Electrical Indicator for Elevators, E. E. Peirce, Boston, Mass., 502,315. Filed July 5, 1892.
Electric Jail, C. H. Sparks, St. Louis, Mo., 502,325. Filed March 28, 1892.
Fusible Cut-Out, E. Thomson, Swampscott, Mass., 502,330. Filed Sept. 17, 1891.
Multiple Fuse, G. T. Voorhees, Boston, Mass., 502,333. Filed May 25, 1892.
Rheostat, J. J. Wood, Fort Wayne, Ind., 502,340. Filed July 15, 1892.
For throwing a graduated resistance into an electric circuit under the control of the operator.
Electric Telemeter, C. H. Haskins, New York, N. Y., 502,399. Filed March 9, 1893.
Employs the principle of the Wheatstone bridge.
Electric Regulator, D. McF. Moore, New York, N. Y., 502,444. Filed Nov. 8, 1892.
For regulating the amount of current admitted to a translating device, such as an electric lamp, by means of an electromagnetic interruptor.
Trip for Releasing Horses, C. C Drake, Trenton, N. J., 502,487. Filed Nov. 26, 1892.
Automatic Cut-out, C. Hoffmann, Berlin, Germany, 502,518. Filed April 11, 1893.
For the protection of lamps and other translating devices.
Two-Pole Switch, C. Hoffmann, Berlin, Germany, 502,519. Filed April 11, 1893.
Electric Safety-Fuse, C. Thalacker, Charlottenburg, Germany, 502,541. Filed May 18, 1893.
Cleat for Insulated Wires, E. H. Clarke, Lynn, Mass., 502,614. Filed March 8, 1893.
Electric Water-Wheel Regulator, E. R. Holcomb, Portland, Ore., 502,694. Filed Jan. 21, 1893.
Employs a dynamo driven by the water wheel and electromagnetic regulating devices controlling the supply of water.

Railways and Appliances :—

Electric Locomotive, R. M. Hunter, Philadelphia, Pa., 502,297. Filed Nov. 30, 1886.
An arrangement of the motor under the car body so as to bring the commutator to the front platform.
Electric Railway-Trolley Base, O. Rau, Jersey City, N. J., 502,530. Filed Oct. 31, 1891.
Converter System for Electric Railways, G. W. Von Siemens, Berlin, Germany, 502,588. Filed March 29, 1893.
Claim 1 follows :
In an electric railway, a source of alternating currents, a moving vehicle upon a line of railway, a motor mounted upon said vehicle to propel the same, an inductional transformer interposed between the generator and motor for modifying the current from the generator, and means for supplying energy from the generator to the motor.
Electric Railway System, G. W. von Siemens, Berlin, Germany. 502,589. Filed March 29, 1893.
Employs alternating currents and a transformer located on the vehicle.
Trolley-Head, R. S. Dobbie, Jersey City, N. J., 502,553. Filed Oct. 31, 1891.
Electric Signal Apparatus, J. W. Lattig, Easton, Pa., 502,626. Filed June 14, 1893.
Applicable to block systems.
Railway-Track Electric Annunciator, J. W. Lattig, Easton, Pa., 502,627. Filed June 14, 1893.
Trolley-Guard, G. Moore, Boston, Mass., 502,639. Filed Aug. 22, 1892.

Telegraphy :—

Relay, H. S. L. Verley, Hoboken, N. J., 502,449. Filed March 27, 1893.
A pivoted coil carrying a contact arm is mounted between the poles of a permanent magnet.

Telephones and Apparatus :—

Portable Telephone, B. S. Flanders, Boston, Mass., 502,396. Filed Jan. 31 1891.
A telephonic signal-box adapted for fire alarm circuits and similar purposes.
Telephone Circuit and Apparatus, J. L. McQuarrie, Boston, Mass., 502,496. Filed May 25, 1893.
For exchange switchboard circuits and specially applicable to trunk lines.
Electric Annunciator, T. Spencer, Cambridge, Mass., 502,472. Filed Feb. 7, 1893.
Adapted to telephone exchange service.
Electric Switchboard-Signal, F. W. Dunbar, New York, N. Y., 502,660. Filed May 15, 1893.
For telephone exchange service.

IMPORTANT ELECTRIC LIGHTING PLANS FOR NIAGARA FALLS, N. Y.

THE BUFFALO & NIAGARA FALLS ELECTRIC LIGHT & POWER COMPANY are now nearly ready with their plans, and bids for the construction of the plant will soon be entertained. Some of the plans have already been accepted and estimates for the building of a 100-foot tunnel for the conveyance of water from the Cliff mill inlet to the plant of the new company are now being figured on. The plans are in the possession of engineers Johnson & Porter and call for a building of stone or brick to be built north of the new Cliff pulp mill located below the river bank. The new structure will be 40 by 80 feet in dimensions, two stories in height and will contain two 250 h. p. generators, which will be operated by three turbines or Pelton wheels under a head of from 200 to 215 feet of water, which will run through a 54 inches steel flume. A tunnel 100 feet long leading from the wheel-pit of the Cliff mill northerly to the river bank will connect with the top of this flume. Engineer Porter states that the building will be so constructed as to allow additions to be made to it at the north end. In this manner more power can be furnished as the occasion demands.

A LITTLE MORE TRUTH ABOUT MUNICIPAL LIGHTING.[1]

In the last quarterly publication of the American Statistical Association, Mr. Victor Rosewater of the school of political science of Columbia College, takes up for consideration an interesting subject—the cost statistics of public electric lighting. It is only fair to say that Mr. Rosewater, who has written quite a little on this question, makes a frank confession of having at one time been deluded into believing that the statistics that had been sent out as representing comparative costs could be closely depended upon, and that his first essay on this subject was written on this basis, just as a number of other articles to which he refers have been founded on a similar misconception. He claims now to have obtained through greater experience more enlightenment, and hence has come to the conclusion that the greater part of the general conclusions which have been drawn concerning the profitability of municipal undertakings of this kind are in no way to be depended upon.

Every one must be aware that within the last few years there has been an earnest effort made by honest, well-intentioned persons to have cities and towns undertake the work of municipal lighting by means of electricity, and the statement has been frequently made that under municipal ownership an electric lighting system could be carried on at a mere fraction of the cost required for municipal lighting under contract. Figures have been given of an exceedingly seductive character, making it appear that it was the height of folly for the taxpayers to pour the money into the coffers of electric light companies, when by a little energy on their own part electric installations could be introduced and maintained at prices far below those named by these corporations for the performance of the same service. There is no sentiment in business, and if this or other cities could make immense savings in this way, it would be sheer folly to go on wasting the money of the taxpayers in the form of large annual payments for electric illumination.

But it is just here that Mr. Rosewater comes in with his criticisms and points out that these figures are singularly misleading, and that the conditions applicable to lighting and the costs of a light are rarely the same in two cities, and frequently quite different in various parts of the same city. For example, in the recent contract given out in New York City, the bid of the United States Electric Light Company was for fifty cents a night per light for seventeen lamps, and forty cents a night for 351 lamps. The increase of ten cents a night, or $36.50 per lamp per year, was demanded in those instances only where no other business outside of the public lighting could be secured.

Then, too, in the time during which lights are maintained there is a wide diversity in different places, and even in the same city or town. Some lights are run from dark to daylight; others from sunset to sunrise; others from 30 minutes after sundown to 30 minutes before sunrise; others from 30 minutes after sundown to 45 minutes before sunrise; some to a moon schedule, and others all of every night. Under this the average hours per night during a year which lights are maintained vary from 3½ to 12. There is, besides this, the power used in developing the electricity, the cost of that power, and whether the men employed as superintendents, linemen, etc., are strictly confined to this work, or whether they perform other services which represent a part of the pay that they receive.

Then, too, there is the difference in the cost of wiring. In some cases this is under ground, in others overhead; in other cases both under ground and overhead. Then, the different methods of lighting produce different results in the cost. The lamps erected upon towers are often quite expensive, and, unlike poles, they cannot be removed from one place to another. Lamps that are bunched into clusters, or, as they are sometimes placed, two on a pole, can have their carbons renewed with less labor than is required when they are on different poles, while the frequency of the lights over the area lighted is also an important factor. Again, the amount of service that a company can perform may make all of the difference between large annual losses and immense annual profits, as certain fixed minimum expenditures have to be met, no matter how small the demand for lighting may be. On the question of depreciation there is a wide margin for differences of opinion, and it may be said that this is usually a point very little considered by the ardent advocates of municipal lighting.

The result is, in Mr. Rosewater's opinion, that there is no possibility of making definite comparisons. Probably the most careful estimate of cost of a municipal electric lighting plant prepared in the United States is that made by those in charge of the system in the city of Topeka, Kan. Here the lights were not run every night, and even when they were run the average for two years was less than eight hours a night, while the average cost was about $93 a year per light. But in St. Louis, where the lights are run every night, from 30 minutes after sundown to 45 minutes before sunrise, the contract price per lamp per year is $74.95, and in Jersey City, where the lamps are run each night from sunset to sunrise, the contract price is $85.83. In Indianapolis, where the lights are run all of every night, the contract price is $62.25. It will be seen, therefore, that, in the opinion of this authority, who has made a very careful and apparently unprejudiced study of this question, it has yet to be determined whether the lights can be run any cheaper by the municipality than by a corporation performing its service under contract.

1. *Boston Herald.*

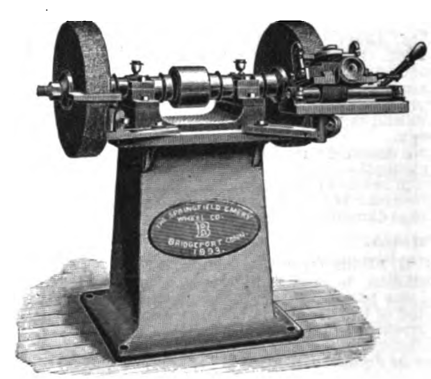
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE SPRINGFIELD EMERY WHEEL COMPANY'S DYNAMO BRUSH GRINDER.

We illustrate herewith a very useful new tool brought out by the Springfield Emery Wheel Company, of Bridgeport, Conn. It is a dynamo brush grinder, with universal slide rest, the clamp being readily adjustable to accommodate any size of brush. The work is moved forward to the emery wheel by a screw with milled head in the back of the rest, and the brush is passed over the face of the emery wheel by means of the hand lever at the right of the rest. Any angle or bevel can be obtained with ease. A customer of the company finds that he can do on this machine in an hour and a half work that formerly occupied all day, and yet the work is now much more accurately done.

The machine here shown weighs 800 pounds and stands 27 inches high from the floor to the centre of the spindle. It occupies a floor space, 20 by 24 inches. The entire length of the spindle is 32 inches. Any size of emery wheel can be used up to 16 inches diameter.



Springfield Dynamo Brush Grinder.

THE ELECTRIC APPLIANCE CO.

The Electric Appliance Company are hard at work on their new catalogue which they promise will be a model of completeness combined with compact form and arrangement. It is their intention to issue a very large edition and they promise soon to put into the hands of the western trade the most desirable electrical supply catalogue that has ever been published. It will undoubtedly be awaited with considerable interest.

The Electric Appliance Company report that their business in electrical house goods does not seem to feel the depression that exists in other lines of electrical trade, and is proving a valuable line to fall back on at a time that other departments are comparatively quiet. The Electric Appliance Company are building up a splendid trade in this line of goods, which has been comparatively neglected for the past few years in the interest of electric light supplies, and their electrical house goods have already established for themselves a first-class reputation among the trade in this material.

HART SWITCHES.

A very tasteful and creditable catalogue of their switches has just been issued by the Hart & Hegeman Manufacturing Company, of Hartford, Conn. It is a model of clear and concise presentation of the merits of a useful and superior line of goods. It illustrates and describes the company's specialties, and enters into all the details needful to a full understanding of the points wherein the peculiar merits of the appliances consist. The Hart switches are well shown up in their various classifications and sizes, as well as the flush plates adapted for use with the switches. A price list is also given.

THE GOVERNMENT BISHOP CABLES AT THUNDER BAY, MICH., AND CHICAGO, ILL.

MR. H. A. REED, of the Bishop Gutta Percha Company, sends us the subjoined very interesting news:

You may be pleased to learn that the Thunder Bay Cables for Weather Bureau in which you were interested last fall, have been laid and are working satisfactorily.

Our bill for cables delivered in Alpena	$7,500
Our expenses superintending, laying and testing	150
Contract for labor in laying	350
Cost of land lines and connections about	3,000
leaving on hand unexpended	4,000
of the appropriation which was	$15,000

The cable was delivered at Alpena last fall, but too late to lay. The land lines were not ready till July when my son Harry and Mr. Charles C. Marks went up and superintended the laying. This was in our contract; the government paying fares and expenses.

The 13 buoys lighted at Chicago by Bernstein lamps in arc circuit are a great success, giving a much better light than the Edison lamps used at Sandy Hook. The 13 buoys are in circuit with the arc lamps which light the long pier forming a very long circuit and requiring an E. M. F. of about 3,000 volts.

We believe this to be much higher voltage than ever before carried on subaqueous cables and much greater distance, as there is fully 13¼ miles of lake cable and probably fully a mile of land line.

TROPP'S PORTABLE ELECTRO-HYDROGEN LIGHTER.

WE illustrate on this page a novelty just brought out under the above title by Mr. B. Tropp, 101 East Ninetieth street, New York city.

The object of this electric lighter is to provide a small temporary light for cigar lighting and for other igniting purposes. Fig. 1 gives a general external view of the lighter, from which it will be seen that the apparatus is ornamental in design, as well as useful. It is a radical departure from other electric gas lighters in its construction. The outside jar is really a battery cell, which contains dilute sulphuric acid (one part of sulphuric acid to six parts of water and two ounces of bichromate of potash) as shown in the cross-sectional view in Fig. 2. The carbon electrode of the battery is shown at E, Fig. 2, and the zinc at J. The zinc is attached at the end of the gas tube G, the whole being placed within a gas tight vessel with its opening at the lower end and placed in the liquid after the manner of a porous cup. The tube G, terminates at its upper end, in a gas tip, and at H is a small hole which allows the accumulated gas within the inverted cup to escape into the upper part of the tube.

FIG. 1.—TROPP'S PORTABLE ELECTRO-HYDROGEN LIGHTER.

In operation, the hydrogen gas given off at the zinc J is collected within the inner inverted cell, and as it accumulates in the upper part, and the pressure increases, the liquid is forced out of the inner cell until it reaches a level below that of the zinc, then the generation of gas ceases until some of that accumulated has been allowed to escape, when the same operation is repeated.

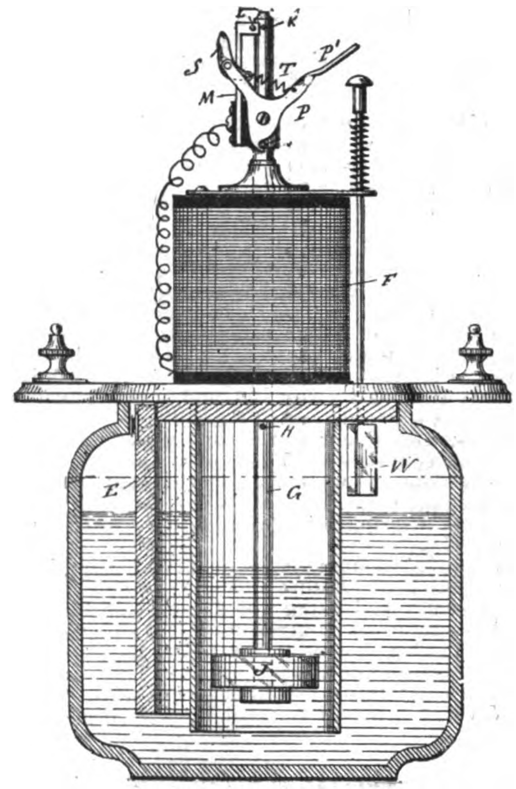


FIG. 2.—TROPP'S PORTABLE ELECTRO-HYDROGEN LIGHTER.

On the outside of the jar, on top, but suitably enclosed, is a spark coil, F, (Fig. 2), one terminal of which is connected to the carbon electrode in the battery; the other terminal is connected with the contact pin L, which is insulated from the gas tube, to which it is attached at M. The lever P, being in metallic contact with the gas tube causes an electric spark to be generated when it is pressed down by the finger plate P, and contact is made with the contact pin L, and by the same movement the gas cock is opened, allowing the gas to issue from the small hole K, at the top of the tube. The electric spark occurring in the path of the escaping gas, the latter is ignited in consequence, burning with the hot blue flame characteristic of hydrogen gas.

In Fig. 2, W is a supplementary zinc which is depressed into the liquid in the cell when the lever P is pressed down. The object of this supplementary zinc was to establish an electric circuit, but it has since been found dispensable and it is not put on the latest form of apparatus. It is unnecessary, because, when the gas cock is turned on once or twice, sufficient gas escapes to allow the liquid to rise in the inner cell to a sufficient height, to more or less immerse the zinc J, thus completing the circuit.

It is said that the inner cell will hold sufficient gas to burn about 10 or 15 minutes, and the cost of the maintenance of the lighter is not over 10 cents a month.

The outside cell is made in Flemish stoneware in blue and granite, and it has a cover of hard rubber, the exposed metal parts being nickel-plated.

NEW YORK NOTES.

MR. R. SCHEFBAUER, of No. 138 River street, Paterson, N. J., besides the manufacture of his safety overhead trolley appliances which were described last week in this paper, also does a general electrical engineering business and is prepared to install complete electric lighting and power plants. Among recent work of this kind carried out by him is the entire refitting of the silk mill of Messrs. Misch & Son with 600 lights and the Fritsche Silk Works with 400 lights. These mills were equipped in the early days of electric lighting and were compelled to put in the most improved modern appliances by order of the Fire Underwriters. They are now fitted out with porcelain cut-outs, rosettes and cleats, according the rules of the Board of Underwriters.

WARREN WEBSTER & CO.

THE above well-known concern, of Philadelphia, have recently removed their large works to Camden, N. J., where they have a spacious and substantial machine shop, three stories, 65 by 150 feet, with new machinery, large steam engine and boiler, a 3-ton traveling crane and all the appliances of a modern, first-class manufacturing establishment. These works will be devoted, like the old, to the production of the Webster vacuum-feed water heater and purifier, the Williames' vacuum system of steam heating, and to the manufacture of the firm's well-known steam and power pumps.

Warren Webster & Co. are exhibitors at the World's Columbian Exposition, and have in operation in the boiler-room of the Machinery Hall, the largest capacity feed water heater ever built, being 4,000 h. p. It is doing duty every hour that the Fair is open, heating and purifying feed water for from 2,000 to 4,000 h. p. as its maximum capacity and heating the above amount for the boilers to which it is connected, from 200 degrees up to 210 degrees Fahrenheit. The heater stands about 10 feet high, occupying seven feet square of space and is connected to an open exhaust pipe, 18 inches in diameter, into which nine condensing engines are connected, some of which run during the day and all during the illumination at night, when the heater does its best work. The exhibit proper is situated on the balcony of the main boiler-room of Machinery Hall, at the west end, and is handsomely and copiously decorated with a myriad of flags.

Besides the large heater and purifier above mentioned, one of 100 h. p. capacity is shown. This is open for inspection to enable visitors to examine and understand the internal arrangements.

About 400 heaters are in successful operation in leading steam plants of every description in this and other countries aggregating over 300.000 h. p.

The Williames' vacuum system of steam heating is guaranteed not to cause any back pressure upon the engine and is notable for its high efficiency in heating and in accomplishing a saving of fuel. It has been installed in about 500 of the largest manufacturing plants, market houses, office buildings, schools, theatres, churches and railroad depots.

Descriptive and illustrated catalogues are furnished by Warren Webster & Co., to parties interested, upon application.

COMMERCIAL ELECTRIC COMPANY.

THE COMMERCIAL ELECTRIC COMPANY of Indianapolis, notwithstanding the dull times, has received a number of orders during the past month. Among these are a 20 kilowatt machine for William A. Schaeffel, New York, and two 30 kilowatt machines for the Union Square Theatre, New York. The company is especially pleased with the order for the two machines for the Union Square Theatre, as this order was secured in the face of strong competition, and illustrates the high reputation which the Commercial machines have acquired during the few months they have been on the market. The company ascribes much of this reputation and their unusual success to their all forged iron field magnet construction, which seems to have met the approval of users and the trade wherever the machines have been introduced.

STANDARD WESTINGHOUSE APPARATUS.

A VERY fine catalogue bearing the classic imprint of Bartlett & Co., has been issued by the Westinghouse Electric and Manufacturing Company. It deals with their standard apparatus, and consists entirely of beautiful illustrations. It is in reality an art album, no attempt being made at all to supply descriptive text. A great variety of apparatus is included, much of which is now to be seen at the World's Fair, and even more of which is now rendering admirable service in electric light and electric railway plants all over the country. Perhaps the most interesting cuts are those in which the apparatus has been taken apart and is shown in all its details ready for assembling. From such pictures, well made, it is easy to ascertain at once the special features of the machine and the distinctive peculiarities of its construction.

ECONOMY NOVELTY CO.

THE ECONOMY NOVELTY CO. has been formed at Charleston, W. Va., for the purpose of making and selling electrical appliances. The incorporators are J. D. Harris, E. C. Legg, R. A. Wathiell and R. H. Hooper, of Baltimore, and J. H. Holcombe, of Washington, D. C.

BAKER & COMPANY'S REFINED PLATINUM.

BAKER & COMPANY, the platinum refiners, have permanently secured the services of Mr. E. A. Colby, the well-known electrician. Mr. Colby will devote his time and attention to conducting a series of experiments, with a view of assisting the firm in turning out the best possible product in their line.

IMPERIAL PORCELAIN.

THE IMPERIAL PORCELAIN WORKS, Trenton, N. J., are making an excellent line of porcelain double petticoat line insulators, and are now introducing them vigorously, believing that they meet a decided want. The threads are absolutely regular and will fit standard pins. They are recommended for alternate current work. The works are also prepared to make switch bases with porcelain screw thread covers. The Duggan cleat already illustrated in these columns is enjoying popular approval everywhere.

GENERAL ELECTRIC MULTIPOLAR GENERATORS.

THE contract for three 1.500 k. w. multipolar railway generators has been awarded by the People's Traction Company of Philadelphia, to the General Electric Company.

These generators will be of the same size as the immense machine now in the power house of the Intramural Railway at the World's Fair, which is at present the largest dynamo in the world.

NEW YORK NOTES.

INTERIOR CONDUIT AND INSULATION COMPANY.—The fan motor work done by this company during the past summer has been something tremendous, although it has been a pretty cool summer. The company are now turning more serious attention to their Lundell generator, which has made a great hit. We illustrated recently its use on Mr. Pierpont Morgan's steam yacht, and now understand that it has been adopted for a large line of coastwise steamers. As for interior conduit, that is used and called for just like wire, and is quite as much an indispensable staple.

MR. J. GODFREY, manager of the New York Insulated Wire Company has recently returned to New York after a prolonged absence in the West on business. He has had a great deal of work on hand in connection with the World's Fair contract, and has had many other important transactions to look after. Despite the dull times, he is not despondent as to the near future, but believes a good deal of business will still be done in America for a few centuries to come.

THE AKRON IRON CO., 206 and 208 Fulton street, New York, have just issued a neat circular in regard to their stock of shafting, pulleys, boxes, hangers, etc., all ready for prompt shipment, and like the cowboy's revolver, "for immediate service." They state that there are few "hurry" orders they do not fill on the day of their receipt. They will send one of their illustrated catalogues, with millwright's tables, to any address on application.

WESTERN NOTES.

ANSONIA ELECTRIC COMPANY.—Some very large contracts for railway material have been placed with the Ansonia Electric Company within the last few weeks. Their new adjustable pipe bracket, as well as the new insulators, are meeting with great success, and are being rapidly adopted as standard material by a large number of electric roads. The Ansonia Company guarantee these fixtures for strength and insulation, and agree to replace any material, which on account of defect, does not prove satisfactory.

THE DETROIT FOUNDRY EQUIPMENT COMPANY, of Detroit, Mich., have issued a very neat and useful map of the World's Fair in vest pocket form, and making incidental reference to their foundry specialities and supplies, crane cupolas, ladles, etc. The map has an index and key, and is beautifully clear in all its details.

PHILADELPHIA NOTES.

THE "MAGGIE MURPHY" LAMP announced by the Pennsylvania Engineering Co., Penn Mutual Building, Philadelphia, is one for which they expect as great a popularity as has been enjoyed by the air from which the name is taken. The company are pushing the lamp most vigorously, and emphasize for it the claims and statements that are made as to its non-infringing qualities and its features of economy and success.

HARRY S. SMITH & CO., LTD., electrical contractors, 607 Chestnut street, Philadelphia, announce that they have taken into full partnership, Mr. Joseph W. Lucas, formerly connected with the General Electric Company at Schenectady.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. AUGUST 30, 1893. No. 278.

A NEW INCANDESCENT ARC LIGHT.[1]

BY L. B. MARKS, M. E.

THE incandescent arc has been described as one in which the "two electrodes are in imperfect contact," the current thereby meeting with high resistance and producing heat effects, which manifest themselves in the incandescence of one electrode and the formation of a number of very small arcs between the uneven parts of the electrodes in contact.[1a]

On this principle, Reynier, Werdermann, Joel, Tommasi and others constructed lamps years ago, but for well-known reasons none of these "semi-incandescent" lamps as they were called, found much practical application. The *Sun* lamp of Clerc and Bureau was a modification of the others, the arc impinging on the surface of a block of marble or condensed magnesia between the tips of the electrodes. In this form there was a rapid waste of the non-conducting substance interposed, and a diminution in the efficiency of the light.

The *incandescent arc* treated of in this paper, differs radically from any of the forms alluded to above. In it, the electrodes are not in contact, while the current is indirectly used in maintaining all the products of disintegration of the carbon in a state of incandescence or opalescence.

Plate A shows the main features of the appurtenance. It will be seen that the arc is enclosed in a small envelope, which is made of highly refractory glass. The envelope is closed at the bottom and provided on top with a metal plug having an opening in it just large enough to admit of the feed of the upper electrode. A fire-proof plug of asbestos-pulp insulates the metal from the glass. A valve shown in the plate allows the egress of gas, but prevents the ingress of the air. With this construction the operation of the lamp will be as follows:

Upon the closure of the circuit, and the springing of the arc, the air in the enclosing envelope is robbed of its oxygen, the latter uniting with the carbon of the electrodes to form CO and CO_2 gases.

The gases are brought to an exceedingly high temperature at which they maintain the carbon-vapor issuing from the arc. This vapor is deposited in the form of a thin coating on the internal surface of the glass chamber.

The expansive force of the gases may become sufficiently great, if no means of egress be provided, to rupture the envelope; hence, a small safety valve is provided for their outflow. The only possibility of ingress of air is through the narrow space between the positive carbon and the plug; experience has shown that after the temperature has been raised beyond a certain point the amount of air that enters in this way is inappreciable; in any event, the oxygen is immediately converted by combination.

It is important that the enclosing glass envelope be as small as possible, for the conservation of the radiant energy, and hence the efficiency will depend largely upon the size of the chamber. The heat which, in the ordinary arc light is dissipated in the air, is here conserved and raises the temperature of the enclosed gases and vapor of carbon. The proper conditions being fulfilled, the lamp maintains its maximum efficiency shortly after the current has been passed through it, and glows like the incandescent with the brilliancy of the arc light. The arc proper is scarcely visible, but the entire contents of the chamber seem to be luminous, giving the appearance of a solid cylinder of light.

The pressure, as well as the temperature of the enclosed gases has a very important bearing on the performance of the lamp, and affects to a marked degree the character of the carbon deposit on the glass chamber. At this date no definite figures can be given but it appears that a high tension is absolutely required to give good results.

1. Abstract of Paper read before the International Electrical Congress, Chicago, August 23, 1893.
1a. Julius Mayer; Arc and Glow Lamps; p. 263.

The structure and constituency of the electrode are also pre-eminently important. Absolute purity of the carbons is imperative.

Investigators in this field have apparently found it impossible to obtain all the requisite conditions. Beardslee[2] mentions a type of lamp similar to the one under discussion, but whether the size or character of the arc-enclosing chamber, the nature or management of the gases, or the quality of the electrodes, or other features made his arrangement impracticable, is not recorded. Suffice it to say, the comparatively poor grade of arc light carbon manufactured 10 years ago would alone explain his failure.

It is interesting to note here that attempts have been made at various times to save carbons in arcs by excluding the oxygen of

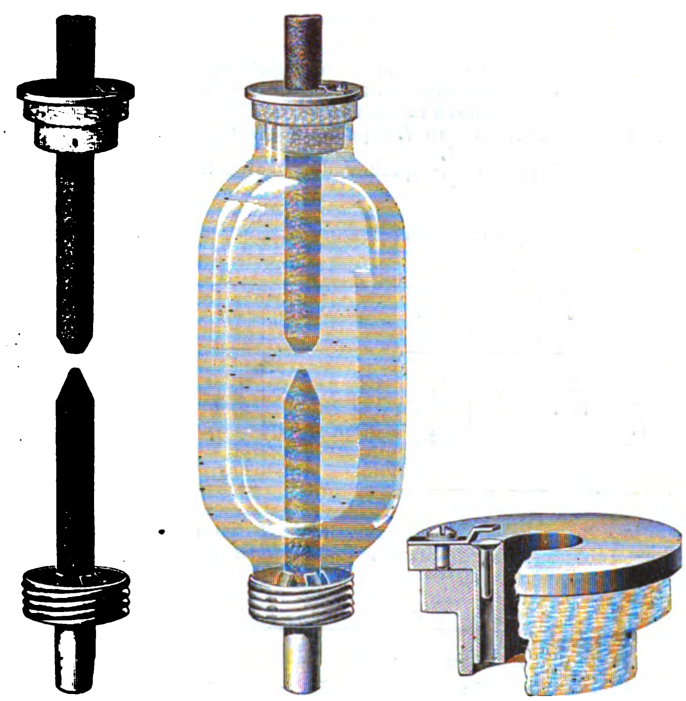


PLATE A.

the air. Baxter[3] devised several forms of arc lamp with this object in view. The subject has been more recently referred to by Thomson.[4] These experiments were attended with little practical success, not because the desired ends were infeasible, but probably because, as in the case of Beardslee's apparatus, alluded to above, one or more of the requisite conditions had not been attained. It appears that the saving in life was more than counterbalanced by the loss in light. The "incandescent effect" was absent, and the unsteadiness of the arc itself was fatal. The results were almost identical with those obtained when the arc is formed *in vacuo*. In this case there is a tendency of the carbon to deposit as a soot on the sides of the vacuum chamber, an effect consequent upon the vaporized carbon in the arc being carried off and condensed again, as soon as the vapor escapes the heat of the arc stream.

But the requisite conditions hereinbefore named being once attained, the arc is really a beautiful phenomenon. It differs in many respects from the arc in open air, being especially steadier than the latter. The light, emanating from the incandescent vapor of carbon appears to issue from all parts of the small enclosing envelope, the area of the source of illumination being limited only by the size of the chamber.

2. G. W. Beardeslee; U. S. Patent, 265,737, Oct. 10, 1882.
3. William Baxter, Jr., U. S. Patent, 288,157, Nov. 6, 1883.
" " " U. S. Patent, 306,993, Oct. 21, 1884.
4. Elihu Thomson: The Electric Arc and its use in Lighting; Paper read before the National Electric Light Association, February 18th, 1891.

Measurements of the efficiency and candle power of the light were made in the laboratory of Cornell University. The method employed in making the efficiency tests was that used by Nakano[5] in determining the efficiency of the arc lamp, and subsequently by

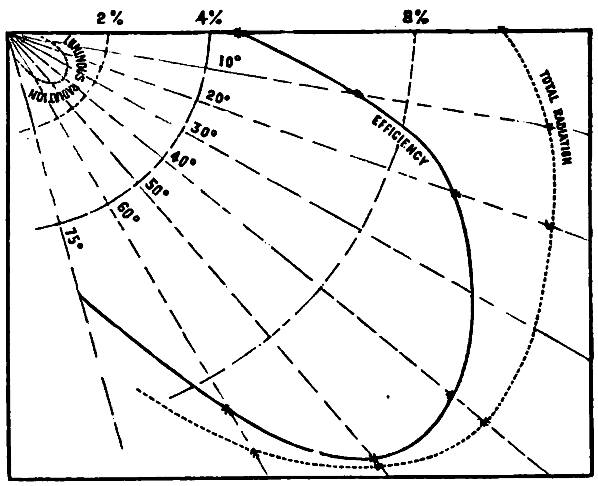


Fig. 1.

the writer in an investigation on arc light carbons.[6] The ratio of luminous to total radiation of the lamp was taken at different angles below and above the horizontal. The values obtained are given in Table I., where L equals luminous radiation, T equals total radiation, and $\frac{L}{T}$ equals radiant efficiency.

Table I.—Efficiency Measurements.

Mean Current = 9 Amp. Mean P. D. = 55 Volts.

Angle	0°	−10°	−20°	−40°	−50°	60°	+ 10°	+ 20°	+ 30°
L	7	12.8	17.	22.	20.5	13.5	8.5	7.	7.
T	155.	175.	180.	195.	180.	155.	135.	135.	135.
$\frac{L}{T}$	.045	.07	.094	.113	.114	.087	.063	.052	.052

Fig. 1 represents the curves platted from these values, the dotted line curves showing the distribution of luminous and total

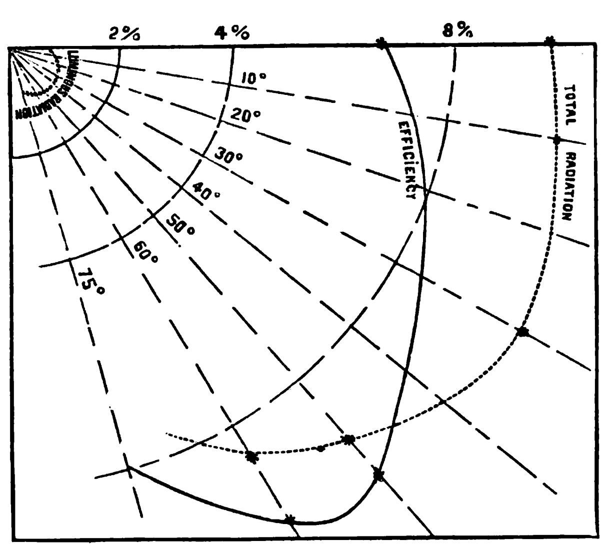


Fig. 2.

radiation respectively, and the full line curve the measure of the efficiency below the horizontal.

5. H. Nakano: Efficiency of the Arc Lamp. Trans. Amer. Inst. Elec. Eng., Vol. VI., page 208, 1889.
6. L. B. Marks: Life and Efficiency of Arc Light Carbons. Trans. Amer. Inst. Elec. Eng., Vol. VII., page 185, 1890.

The value of the mean hemispherical efficiency is obtained by integrating the curve, and is found to be 8.4 per cent. The mean efficiency of the ordinary arc is about 10 per cent.[7] The mean efficiency of the incandescent lamp, according to Merritt[8] is rather below than above 5 per cent. The value obtained in the test of this new light therefore lies between those of the two present forms of electrical illumination, approaching, however, more nearly that of the arc.

While it is true that the average efficiency of the electric arc in open air nets about 10 per cent., it is questionable whether in commercial practice in this country the value is often reached. The writer has made tests of a standard brand of arc light carbon where the efficiency was only 7¾ per cent.[9]

Glancing at Fig. 1, we note that while the form of the efficiency curve differs entirely from that of the incandescent lamp, it is not unlike that of the arc. The distribution of light-giving energy is, however, more uniform than in the arc, a fact which is more prominently brought out in comparing the candle power curves of the two. While the approximate law, *Hemispherical efficiency*, = ¼ *horizontal*, + ¾ *maximum*, holds for the ordinary arc, the mean of several tests indicates that—

Hemispherical efficiency = ⅓ *horizontal* + ⅓ *maximum*, fairly represents the conditions manifested by the *incandescent arc*, curves, Figs. 1 and 2.

Tests were made to determine the effect of initially coating the internal surface of the cylinder with various ingredients other than carbon. No marked difference in the efficiency was discovered. Fig. 2, platted from values in Table II, represents a

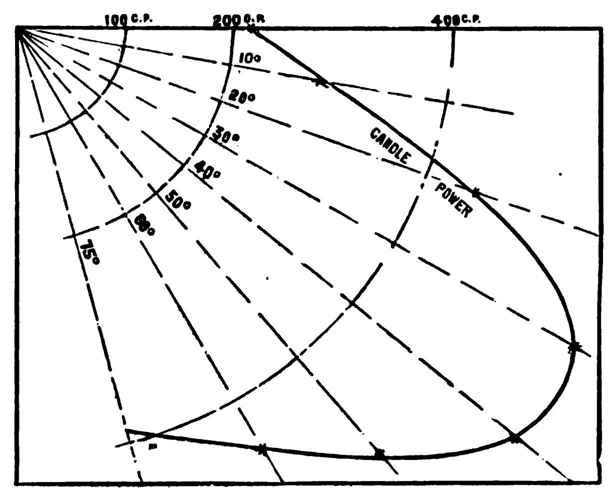


Fig. 3.

curve taken in this way. The mean hemispherical efficiency was 8.02 per cent.

Table II.—Efficiency Measurements.

Mean Current = 9 Amp. Mean P. D. = 55 Volts.

Angle	−0°	−10°	−30°	−50°	−60°	+ 20°	+ 40°
L	10.5	12.0	14.0	15.5	14.0	10.5	8.50
T	155.	160.	170,	150.	140.	155.	150.
$\frac{L}{T}$	.068	.075	.082	.103	.100	.068	.057

Table 3 gives the candle power measurements from which the curve, Fig. 3, was platted. Distances measured along the radii give the candle powers for the various angles throughout the "zone of useful illumination."

Table III.—Candle Power Measurements.

Mean Current = 8 Amp. Mean P. D. = 63 Volts.

Angle......	0°	−10°	−20°	−30°	−40°	−50°	−60°	+20°
Candle Power.....	218	283	455	590	595	515	450	170

7. H. Nakano: l. c.
8. E. G. Merritt: Amer. Journal of Science, Vol. 37, page 167.
9. Trans. Amer. Inst. Elec. Eng., Vol. VII., No. 6 and 7, page 203.

It will be seen that the distribution of light as shown by the candle power curve differs considerably from that of the ordinary arc. Especially is this true at angles greater than 50° below the horizontal. The turn in the curve is not so sharp as in the arc, and there is much less difference between the maximum and the mean amount of light; in fact to the naked eye the intensity of luminous radiation does not seem to vary much from 20° to 60° below the horizontal, while in the arc the change is very marked between these limits, Thus the formula of Gerard [10], namely:

Hemispherical c. p. = 1.2 *horizontal c. p.* + 1.4 *maximum c. p.*, which may be used to advantage in arc light approximations, will not hold in this case; but the form of the curve, as well as the nature of efficiency curves above referred to, suggests the substitute.

Hemispherical c. p. = 1.2 *horizontal c. p.* + 1.2 *maximum c. p.*

The mean or hemi-spherical candle power below the horizontal, obtained by integration of curve Fig. 3 equals 431, thus allowing 1.17 watts per candle, or 637.6 candles per electrical horse power, —nearly three times the average illumination of the incandescent lamp using the same energy.

The results of tests show that the mean hemispherical candle power of the ordinary arc measured as in the above case, averages about 600; the mean watts per candle, .84 or 888 candles per electrical horse power.

Comparing these measurements with those of radiant efficiency, it appears that the ratio,

$$\left\{\frac{\textit{Hemispherical c. p., ``incandescent arc.''}}{\text{Hemispherical c. p., ordinary arc}}\right\}$$ is considerably smaller than ratio, $$\left\{\frac{\textit{Hemispherical efficiency, ``incandescent arc.''}}{\text{Hemispherical efficiency, ordinary arc.}}\right\}$$

The explanation of this difference undoubtedly lies in the quality of *luminosity* of the light emitted by the *incandescent arc*. Nichols [11] has pointed out that the relative efficiency, as determined by the ratio $\left\{\frac{\textit{luminous radiation}}{\text{total radiation}}\right\}$ "does not coincide with that obtained from the ratio of watts to candle power, for the reason that the various rays which make up the visible spectrum, do not enter into the production of candle power in proportion to their energy." Luminosity is a potent factor in determining the real efficiency of any source of illumination. Lack of time has prevented the investigation of this important phenomenon, but, at its maximum efficiency the light from this form of *incandescent arc*, though not so intense, unmistakably appears brighter than that of an ordinary arc of equal candle power as interpreted by the photometer.

Oxygen being practically excluded from the arc-enclosing chamber, prolongation in the life of the electrodes is an implied concomitant.

In the ordinary arc "while the positive carbon loses by volatilization from its tip or crater, and by combustion from its sides, the negative gains no deposit, but wastes at a less rate than the other, and by *combustion only*."[12]

Hence, if the exclusion of oxygen were complete, we might expect an indestructible negative. This condition, however, has not been fulfilled in any of the tests made thus far, but the the results fully substantiate the theory. Absence of combustion on the one hand, and the tension of the enclosed gases on the other, combine to greatly reduce the amount of disintegration of the positive electrode.

Table IV. gives the results of the life test with a pair of pure carbons, ½ inch in diameter, and specially constructed for the purpose.

The lamp was placed in the circuit of a constant current dynamo, running about eight hours per day; readings were taken at given intervals and the total length of run was limited to 100 hours.

TABLE IV.—LIFE TESTS.—½ INCH CARBONS.

Mean current 9$\frac{6}{10}$ Amp. Mean P. D. 55 Volts.

Initial length (x) carbon (inches).	Initial length (—) carbon (inches).	Duration of run (hours).	Loss in length (x) carbon (inches).	Loss in length (—) carbon (inches).	Life per inch (x) carbon (hours).	Life per inch (—) carbon hours.
10.81	4.63	100	6.81	0.69	14.67	145.45

Thus making 1 69 inches per hour as the average consumption of carbon in the commercial 350 watt lamp, run at 5½ amperes and 50 volts, [13] we note that although 525 watts, or one and one half times the energy have been expended in the case of the lamp under consideration, yet the life per inch of carbon consumed is more than 20 *times* that of the other. Indeed, the figures show that the life of the negative was nearly 100 *times* as great as that obtained in commercial practice to-day.

The preservation of the negative is a very interesting feature of this type of lamp. There is a marked tendency towards deposition of the products of volatilization of the upper electrode, on tip of the lower, the carbon deposited, if not ruptured by the action of the lamp, forming an integral part of the negative.

In one case where, the arc having been sprung, the electrodes did not come in contact during the entire run, this "building up" process was beautifully exhibited, the negative electrode gaining practically all that the positive lost. The current in this instance was 10½ amperes and the P. D. 50 volts. The duration of the run was 11 hours.

Relation of P. D. to length of Arc and Quality of Carbon.—The effect of the enclosed gases on the form and character of the arc presents a large field for investigation.

The difference in potential between the electrodes being equal, the *incandescent arc* is longer for a given current, than the ordinary arc; under some conditions it has been found to be almost twice as long. If we accept the conclusion of S. P. Thompson, that "the arc is independent of the nature of the surrounding gas,"[14] we must then look to the effects of the tension or pressure of the heated gases upon the arc to explain this difference in length. It has been found that there is a constant increase of P. D. with pressure above atmosphere, for a given current and length of arc.[15] But in spite of this fact, the decrease in resistance of the arc under the conditions named appears to allow of a greater length for the same P. D.

In the ordinary arc the carbon vapor carried off from the positive is consumed by the oxygen of the air before it can deposit on the negative. Hence the ever present "zone of flame" as distinguished from the arc-flux proper is really a zone of combustion. In the *incandescent arc*, however, there is naturally no zone of flame, consequently the phenomenon of *flaming* common to the ordinary arc, does not occur. The arc tends to centre itself, being probably aided in so doing by the pressure of the surrounding gases; moreover, the slow consumption of the electrodes lessens the tendency to wander. With cored carbons there is a perceptible crater, but with solid pencils the tips become more or less flattened.

The quality of the carbon has an important bearing on the P. D. between the electrodes. Generally speaking, it has been observed that with soft fine-grained carbons the P. D. is considerably lower for a given current than with the harder or coarse-grained pencils. The tendency to *hiss*, however, is not so marked when the electrodes are consumed in the gas chamber as in the open air; in the former case the disintegration is so slow that the "electrolytic" vaporization, as it has been called, does not appear to explode the particles. It is interesting to note here that these results confirm a theory of *hissing* advanced by Prof. Thomson a few years ago.[16]

No measurements were made using the alternating current; but the appurtenance was applied to the alternating current arc lamp to determine the effect on the noise of the arc. The *hum* was in a large measure reduced, but whether the reduction was due mainly to the mere fact of the arc being enclosed in an air-tight compartment or not, is questionable. But, as the *hum* became much slighter after the lamp had been in operation several minutes, the action of the heated gases being then manifest, is is plausible that the diminution in the noise was not due entirely to the shielding property of the glass envelope.

While it has been proven that "the humming of the alternating current arc is due to the rapid periodic extinction and re-establishment of the discharge,"[17] the singing tone may be greatly modified, if not entirely overcome, by the substitution of an incandescent arc of the Reynier type. A few years ago the writer had occasion to test an alternating current arc lamp trimmed with carbons which had been provided with a core of pulverized mica and carbon. The springing of the arc was accompanied by the usual *hum*, but as soon as the mica fused, the noise ceased. The conditions were similar to those of an *incandescent arc*, the plastic mica-carbon core constituting a high-resistance medium between the plus and minus electrodes. There was really no true arc. The amount of light was naturally greatly reduced. In the case of the *incandescent arc* first alluded to, there seems to be an approach to these conditions, the arc-stream acted upon by the gases enclosed in the chamber appearing to have a greater density, if we may call it that, than under normal circumstances. The amount

10. M. Gerard: Candle Power of Arc Lamps. *Centralblatt for Electrotechnic*, Jan. 1890.

11. Dr. Edw. L. Nichols: The efficiency of methods of Artificial Illumination, Trans. Amer. Inst. Elec. Eng., Vol. VI., No. 5, May, 1889.

12. Elihu Thomson, l. c.

13. E. F. Peck, carbon tests. Paper read before the National Electric Light Association, February, 1890.

14. S. P. Thompson: On the Physics of the Voltaic Arc. Paper read before British Association, Section A, Edinburgh, August, 1892.

15. Dr. Louis Duncan, A. J. Rowland, R. I. Todd. THE ELECTRICAL ENGINEER, Vol. XVI., No. 274, page 99, 1893.

16. Elihu Thomson: Trans. Amer. Inst. Elec. Eng., Vol. VII., Nos. 8 and 9, page 274.

17. Dr. Edw. L. Nichols: A photographic study of the Electric Arc. Trans. Amer. Inst. Elec. Eng., Vol. VIII., Nos. 6 and 7, 1891.

of light in this experiment, was, however, apparently as great as in the direct current tests.

Unquestionably this form of *incandescent arc* must have a wide application in the arts. As a substitute for the ordinary arc light, where greater steadiness or longer life is required, its superiority will be manifest. And its utilization, where at present the incandescent lamp is the only satisfactory source of illumination, also presents a large field. The effective distribution of luminous energy and the color of the light, makes it for many purposes a desirable mean between the incandescent and the arc.

As a standard source of illumination for arc light comparison and measurements, it may be of much scientific as well as utilitarian importance.

The investigations have been carried out under the direction of Mr. Louis E. Howard, and many of the facts herein stated are due to him. The writer is also indebted to Dr. Edw. L. Nichols, Franklin L. Pope and Robt. H. Read for valuable suggestions; to Mr. C. Ransom for life tests, and to Messrs. Wm. C. Hubbard and E. S. Ferry for assistance in the efficiency and candle power measurements.

(A summary of the discussion on this paper will be found in our report, elsewhere in these columns, of the Congress proceedings.)

OCEAN TELEPHONY.[1]

BY SILVANUS P. THOMPSON, D. SC., F. R. S.

THAT a submarine cable clad in its coating of gutta-percha woul retard the rate of signaling was predicted by Faraday, and verified when the first long cable was laid. Many have been the subsequent devices to increase the speed of signaling by the use of

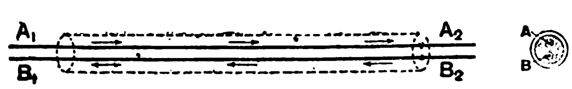


FIG. 1.

condensers and the like. They have all been devices to be applied either at the transmitting, or at the sending end, or at both. In spite of the use of condensers, of artificial cables, and of inductive shunts, the retardation of the long submarine cable has proved hitherto insuperable save for slow signals. In the sending of each signal the gutta-percha coating becomes charged, and this charge must be, as it were, swept out before the next signal can be sent. Retardation trumphs over the telephone and the automatic rapid telegraph.

And yet no reasonable electrician can doubt for a moment that ocean telephony must come, or that the resources of science are equal to the solution of the problem.

If the solution at which the author has arrived seems strange to the ordinary telegraph electrician or cable engineer, it is because that solution has dawned upon him out of a different domain of science, namely, from the study of alternate current phenomena. If the solution he now propounds seems impracticable to cable engineers accustomed to the old type of cable that has persisted now for 30 years, he would reply that it is the business of the engineer to make it practicable.

The retardation of signaling, which is found in submarine cables, is due to the capacity of the cable, and this capacity is distributed fairly uniformly along the cable. Owing to this circumstance, all attempts made hitherto to annul or compensate its operation by means of devices situated at the *ends* of the cable, have met with very limited success. Whereas, the ordinary speed of signaling through an Atlantic cable is about eight words or so per minute, it would be quite possible to send 400 words per minute through a line of the same resistance, but destitute of capacity.

The only effective way to annul the retarding effects of a *distributed* capacity is to apply a *distributed* remedy; that is to say, abandoning the idea of compensating it by devices placed at the ends of the cable, means must be sought for applying compensating devices *distributively* along the length of the cable, either at intervals or continuously.

There are a very large number of ways in which, theoretically, the end may be obtained of compensating the effect of the distributed capacity by means of distributive electromagnetic induction. It will suffice here to consider two simple cases, and for the sake of simplicity it will be supposed that each is applied to the case of a cable containing two insulated wires for the outgoing and returning currents. Such a cable may be represented in Fig. 1, where A A is the out-going wire or "line," and B B the incoming wire or return. In the subsequent figures the sheathing will not be specifically indicated.

1. Abstract of a Paper read before the Electrical Congress, Chicago, Aug 21-25, 1893.

CASE I.—*Use of Self-Induction Devices Distributively.* In this case a series of self-induction coils of sufficiently high resistance and sufficiently great inductivity are placed across at intervals from the A conductor to the B conductor. In order the better to follow the action it will be convenient to represent the disturbed

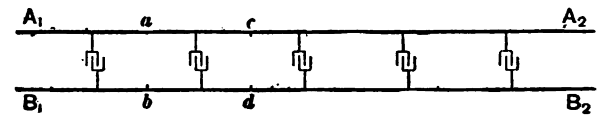


FIG. 2.

capacity as in Fig. 2. In this case, whenever the potential at any part of the line is rising, some of the current tends to flow into the condenser at that part, with the result that the rise of potential in that part is delayed, while the current beyond that part is for the moment smaller than the current that is coming up to the part. Further, when the potenial at any part is falling there is a tendency for current to flow out of the condenser at that part, and thereby keep up the potential a little later; so that at that moment the current flowing away from the part in question is greater than that flowing towards the part. If nothing is done to compensate this action, the effect would be that virtually all the wave thrown into the cable A_1 would be taken up in playing into and out of the successive condensers, and so only an insignificant and much-retarded fraction of it would reach the end A_2.

Now suppose that self-induction coils are placed across the cable at the proper intervals, as in Fig. 3. In this case the respective actions of the self-induction coil and of the condenser are of opposite kinds. One tends to cause the changes of potential in the line to occur *later* than they should occur; the other tends to cause the changes of potential to occur sooner than they otherwise would occur. Hence their action tends to com-

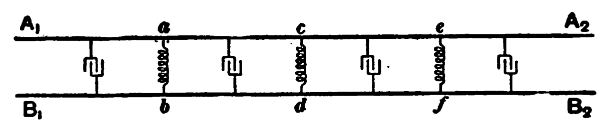


FIG. 3.

pensate one another if applied at the same place. But the capacity of a line or cable is not at one place; it is distributed along it. Therefore it is essential that the compensating devices should also be placed all along it, at sufficiently frequent intervals. The compensators act as leaks across from the A line to the B line, which by their inductive action sweep out the accumulating charges that would otherwise retard the signals. Some calculations on the magnitude of the currents that must thus flow across in the compensating coils have been made by the author, and some others for him by Dr. Sumpner. From these it appears that taking as a working basis the actual facts about cables as they are, and assuming a twin wire cable having a capacity of one-third microfarad, and a resistance of 10 ohms, for a mile length, also assuming that compensating coils are placed across at every 10 miles, if such coils have a coefficient of self-induction of 100 henrys and a resistance of 3,000 ohms each (its time-constant being then about $\frac{3}{100}$ths of a second), the rise and fall of current in each section will, with currents of the ordinary telephonic periodicity, be practically instantaneous in each section during the very small fraction of a second that the impulse lasts; and the value of the current from section to section will be practically determined solely by the shunting action of the successive compensators. Now, as telephonic currents may be shunted down to an extra-

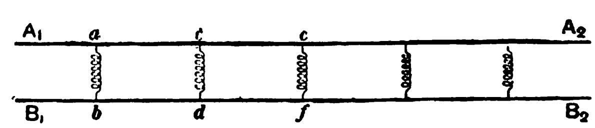


FIG. 4.

ordinary degree of tenuity, and yet be perceptible, it is evident that there are great possibilities opened out by this method of using the shunted portions of the current to neutralize the retardation.

The cable so constructed of two wires with compensating devices shunted across at intervals of 10, 20, or it may be 500 miles apart, will be represented diagrammatically by Fig. 4. The practical problem then remains how to provide compensators having a sufficiently great time-constant without their constituting

unwieldy enlargements of the cable. This is a very simple matter of construction. The author has tried several species of devices, some of them resembling elongated "hedgehog" transformers made very long and thin, and wound with one coil only

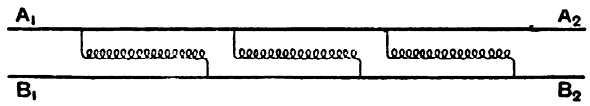


FIG. 5.

of fine wire; others consisting of "shell" transformers elongated into a very long, narrow loop; others again consisting of simple iron wire, straight or looped, or of wire over-wound with a layer of iron wire. The self-induction, for example, of a one-millimetre iron wire, overwound with a layer of iron wire three millimetres deep, is roughly about 0.1 henry per kilometre; and its resistance is 144 ohms. One point in favor of the use of loaded straight wires as self-induction devices is the circumstance that the compensator need not join two adjacent points in the two conductors within the cable, but may lie across as in Fig. 5. This construction, which is specially suitable for cables of moderate length, resolves itself into a three-wire cable, of which one wire is loaded in

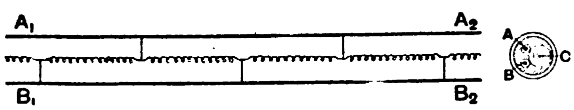


FIG. 6.

some way to give it self-induction and resistance, and is connected at intervals alternately to the other two, as in Fig. 6.

As stated above, however, not only by self-induction but by mutual induction, the retarding effects of capacity may be neutralized.

CASE 2.—*Use of Mutual-Induction Devices Distributively.*—In this case the cable is considered in sections, each of which is in inductive relation with those on each side of it; and again there are many possible varieties included. One example is shown in Fig. 7.

In this figure it is indicated that the coils are so connected that

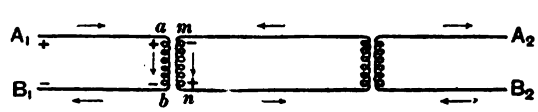


FIG. 7.

in the A line when the current is increasing and flowing toward a, the inductive action will be causing a current in the next section, which will be at the same instant increasing, but flowing, so far as the A line is concerned, in the opposite sense, so that while the potential of the point a is rising that of the point m is falling. The consequence will be that the currents required to sweep out any accumulated charges due to capacity will not have to travel (as in ordinary cables) all the way from the ends of the cable, but need only travel short distances, never more than the length of half a section. Hence, if a cable 2,000 miles long is cut up into 25 sections of 80 miles each, there should be no more retardation than on an ordinary cable 40 miles in length. It is not needful that both the lines should actually be divided; a virtual division into

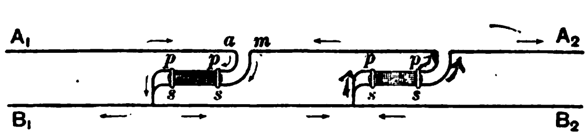


FIG. 8.

sections is effected in Fig. 8, where the B line is actually continuous. In this figure p p is the primary, and s s the secondary (or *vice versa*) of the mutual induction coil. Or the arrangement may be alternated, as in Fig. 9.

Or again, if three conductors are employed—of which one may be the sheathing—the sectioning and use of mutual induction may be accomplished as shown in Fig. 10.

Here, again, as remarked above, the kind of induction coil which naturally suggests itself as suitable for the purpose in question is something of elongated shape, such as a very elongated loop "shell" transformer, or the "cable" transformer which was suggested for electric lighting purposes by Messrs. Siemens & Halske some years ago. Or, as the author suggested in 1891, by using a mutual induction between the wires of the cables themselves by merely enwrapping them, as they lie side by side, with iron. So that the cable once more becomes an arrangement of three parallel wires, of which two are specially brought into mutual inductive relations to one another, and are joined up at intervals, as indicated in Fig. 11.

Lastly, it is, as is well known, possible to have mutual induction between two wires that do not form part of closed circuits, as in the phonophore of Mr. Langdon Davies.

In regard to the evidence as to the practicability of using induction devices distributively to compensate retardation, the

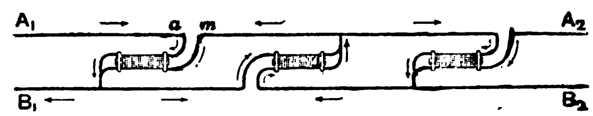


FIG. 9.

author cites a number of examples including the methods employed by Varley, Winter, Willoughby, Smith, Edison, Lockwood, Carty and Preece. It is therefore reasonable to suppose that by systematizing the arrangements, and by providing a cable with inductive shunts at proper intervals all along so as to balance the capacity from point to point, in a distributive manner, the longest cable can be made to transmit speech, and, if speech, the less frequent impulses of automatic telegraphs.

Many experiments have been made in the author's laboratory with arrangements of apparatus set up to imitate by condensers and resistances the retarding properties of actual cables. An example will suffice. A section of artificial cable was made up of a resistance of 7,000 ohms, and a capacity across between line and earth of ten microfarads. Through this cable not a sound could

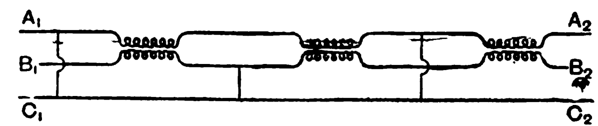


FIG. 10.

be transmitted telephonically to a double-pole Bell receiver at the distant end, either with a Blake transmitter (with induction coil), or with a Hunnings transmitter without induction coil. When, however, a single compensating self-induction coil, having a resistance of only 312 ohms, and a time constant of about 0.005 second, was bridged across at an intermediate point, telephonic transmission became at once possible, save for very shrill sounds.

One curious result came out in one of the series of experiments, namely, that those telephonic transmitters which have induction coils in them (the ordinary mutual-induction coils with thick and thin winding), are almost useless for the purpose of cable transmission. Apparently the fine wire winding has too great a

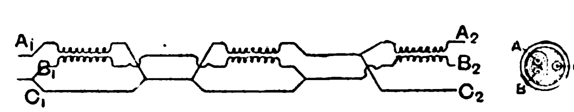


FIG. 11.

self-induction in series in the circuit to be suitable for this purpose. At any rate, better results were obtained from transmitters of other types. Quite recently the author has got better results from a transmitter in which the ordinary two-wire mutual induction coil was replaced by a single self-induction coil on a plan suggested by him in 1884. It is obvious that any plan which contemplates the counter-balancing of retardation by shunting (through self-induction coils) a notable fraction of the current may necessitate a new type of transmitter capable of sending telephonic currents of much greater amperage than those ordinarily used in overland telephony.

So far, the evidence for the effective operation of self-induction has been considered. But there exists also much evidence to show that mutual induction by devices properly distributed along a twin-wire cable will also be effective in neutralizing the retardation due to distributed capacity. It is an old and well established rule that the retardation in a cable is proportional to the square of its length. If one could cut a 2,000 mile cable into two cables of 1,000 miles each, and simply translate or relay the current from one into the other, the retardation of the whole ought to be reduced very materially, perhaps not to one-quarter, but at least to one-half. Only here, again, it is evident that some of the elec-

tric energy supplied at one end must be used up in the act of working the translator or relay, however it is constructed, even if it be only a simple mutual induction coil.

For the particular purpose in question—namely, that of enabling the circuit to transmit telephonic signals—the induction devices must not be simple ordinary coils inserted haphazard at intervals; they must be specially designed and inserted with perfect regularity. And the cable itself must be freed as far as possible from self-induction. *Never, for such a purpose, must a cable be constructed, as Atlantic cables have hitherto been, of a single conductor* (of stranded copper) *surrounded by an iron sheathing* that comes in between the outgoing and the returning parts of the circuit, thus adding an enormous impedance. Happily, in all twin cables where outgoing and returning conductors lie side by side within the sheath, the iron of the sheath, enclosing both, increases the mutual induction between them.

The author concludes that ocean telephony is possible. The means for attaining it are within our grasp. Compensated cables of the new type are entirely practicable. It may be needful to begin with some shorter line than an Atlantic cable, in order to gain experience. But an Atlantic cable constructed on the new plan will not cost much more, when laid, than one of the old type; and whether or not it is successful in conveying telephonic speech, it will certainly transmit telegraphic messages at a greatly accelerated speed of signaling. If one Atlantic cable can be constructed to do the work now requiring eight cables, that cable will be constructed. Acceleration of the ocean telegraphic service is in itself a desirable step in advance; but the advance will not be complete until telephonic speech is transmitted also from shore to shore.

(For discussion, see report of Congress proceedings.)

A ROTARY MERCURIAL AIR PUMP.[1]

BY DR. F. SCHULZE-BERGE.

THE author states that of the different types of mercurial air pumps which have been devised so far two have been introduced into practice on a large scale, viz., the Geissler and the Sprengel pump. Both are represented in numerous modifications, and have undergone manifold improvements in the course of time. They produce vacua of the highest grade, but compared with the mechanical piston pumps both of them are under the disadvantage of working only very slowly, so that they do not appear fit for evacuating receivers of large volume. On the other hand, even the most perfect of the mechanical air pumps are far behind the mercury pumps so far as the degree of the vacuum produced is concerned. To combine the advantages of both systems the author in connection with his brother, Mr. Herman Schulze-Berge, has constructed a rotary air pump which allows the creation of extensive vacua of excellent quality in a very short space of time.

They have carried out the apparatus in a number of different forms, all of which are based on the same principle. The pump vessel is formed by a curved tube, returning into itself, which revolves in constant direction around a stationary axis of rotation. A mercury piston passing through the interior of the tube creates on the one hand the vacuum, and expels on the other hand the evacuated air, while the connections required of the pump vessel with the receiver and the atmosphere are effected by stopcocks or suitable valves. A number of pumps based on this principle are described.

Such pumps do not require any manipulation except a simple rotation. They can therefore be easily run by machinery. In the most improved type, pump vacua of so high a degree as to escape measurement by the McLeod gauge have often been created. For that purpose, of course, it is necessary to provide for the absolute dryness of the mercury and of all parts of the pump and the receiver. As drying material in producing high evacuation they have used metallic sodium with good success. It eagerly absorbs humidity, and while giving off hydrogen, is covered with a layer of caustic soda. As the latter is highly hygroscopical, it adds efficiently to the drying action of the metal. A pump in which the outer ring had a diameter of 60 centimetres and a capacity of 0.9 litre, permitted 15 revolutions per minute when rotated by hand. At present a larger machine for industrial purposes is in course of construction, in which the volume of the outer rim amounts to 8.5 litre.

(For discussion, see report of Congress proceedings.)

WIRES IN NEW YORK.

THE BUREAU OF INCUMBRANCES has been directed by the Board of Electrical Control to remove the Thomson-Houston Company's poles and wires at Twenty-fourth street and First avenue.

The application of the Broadway Railroad Company for permission to run telephone and telegraph wires through its cable conduits has been referred to Corporation Counsel Clark for decision.

1. Abstract of a Paper read before the International Electrical Congress, Chicago, Aug. 21-25, 1893.

THE PROPOSED COTTONWOOD POWER TRANSMISSION IN UTAH.

MR. R. M. JONES, of Salt Lake City, Utah, sends us the following information with regard to the proposed Cottonwood power transmission with which his name is connected:

"My application at the "Stairs" in Big Cottonwood Cañon will develop above 2,000 h. p. during the lowest stage in the water flow, and about nine months in the year, the power will reach above 3,000 h. p. I have a natural reservoir which will retain 70 hours' supply of 2,000 h. p., without being replenished from the stream above. This reservoir is a natural one and cannot be broken away by high water. I am now putting through a tunnel a distance of 480 feet, through which will be conducted round redwood fluming to the steel headgates in the reservoir. The headgates will be about thirty feet below the surface, and about eight feet from the bottom of the reservoir, and at a point 1,100 feet from where the stream enters the reservoir, making it impossible for slush ice or anchor ice to interfere with the workings. The pipe line will be 60 inches in diameter and cemented in the tunnel. From the lower end of this wood-pipe line will be connected a steel-pipe line extending down the mountain side 1,900 feet to the location of the power house. In this length of pipe, I obtain 886 feet head and a volume exceeding 3,000 cubic feet of water per minute at the lowest stage. The power-house location is 18 miles from the business centre of Salt Lake City. There is at present in use something over 3,000 h. p. in steam power plants within the limits of the city, principally in electric lighting and in electric railway work, making my supply insufficient to meet the present demands. This in consequence of the high price for coal in this market together with many other points of advantage, will make the installation a very successful one financially, and, I believe, within the near future, will show as one of the most important long-distance transmission of power stations in the country. My present intention is high potential, alternating transmission, whether with two sets of transformers, will depend upon the success others have attained by such applications. The question of phase is also undetermined. I am at work at present incorporating this enterprise, and inasmuch as I have a franchise from the city to distribute mains and feeders through all of its streets, also from the county for the pole-line construction over its various roads to reach the city, I feel that the preliminaries of this undertaking are quite well provided for."

POTENTIAL OF THE ATMOSPHERE.

WHAT is the difference of potential between the air at the top of the Eiffel Tower and of the ground at the foot? This is the question, interesting alike to electricians and to meteorologists, which has been put to and the answer sought by M. Chauveau, of the Meteorological Department at Paris. The result is rather astonishing. One would expect a few volts difference of potential—even a few hundred volts. But the answer is 10,000 volts! This certainly seems extraordinary at the height of 1,000 feet only, yet on a recent visit to the Eiffel Tower one of our representatives, says the London *Electrical Engineer*, saw the attendant at his tests, and the amount was then over 7,000 volts. A noticeable spark, clearly seen and heard in broad daylight, of some millimetres length, was taken from the outside knob. This apparatus is of the simplest, but accurate means of measurement are installed. A Thomson battery of several hundred volts as standard, a reflecting potentiometer, and a photographic register of the light spot are the means used for obtaining the curves of rise and fall of potential. Plotted against curves of thermometer, barometer, and hygrometer, this will probably tell an interesting tale. The means of obtaining the potential of the surrounding air adopted is that suggested by Lord Kelvin, of discharging fine streams of water. A small tube attached to a cistern of water projects out into the air for some six or eight feet. The tube and cistern are very carefully insulated, and a wire is led down to a knob within reaching distance, also highly insulated. On turning on the water jet a fine stream of water floats away on the air; in a minute or two the whole apparatus, which has some considerable capacity, is charged and sparks can be obtained. In registering, a wire is carefully taken through into the dark room and registers automatically in the way mentioned. M. Chauveau devotes a good deal of time and attention to this interesting experiment, mounting the Eiffel Tower, every day, rain or shine, and on some days in winter when the wind blows a perfect gale this is by no means a pleasant or even a safe task. In winter, of course, the reading is very difficult, for the water freezes, and the other way to obtain the potential, by means of a gas flame, is not less troublesome. Sufficient curves have been taken, however, to lead to interesting results. The potential rises and falls in well-defined curves, and very nearly a year's records have been obtained. The potential varies very much—from 3,000 to 7,000 volts is common—and on a brilliant, clear day at this time of the year 10,000 volts, we were told, was not uncommon.

ON THE CARRYING CAPACITY OF ELECTRIC CABLES, SUBMERGED, BURIED OR SUSPENDED IN AIR.[1]

BY A. E. KENNELLY.

THE author, after referring to the work of Prof. Forbes on the heating of conductors, takes up the question and develops it, bringing to his aid a series of measurements made at the Edison Laboratory on samples of Siemens cable manufactured at Schenectady at the works of the General Electric Co.

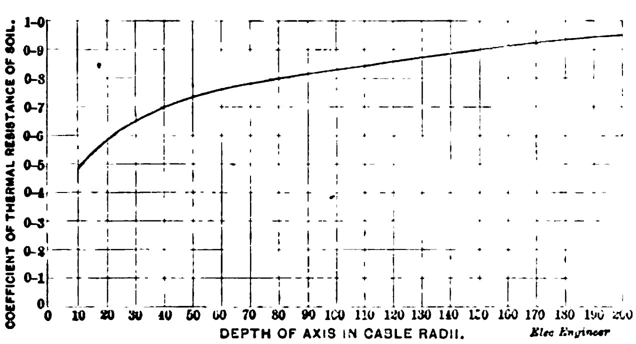
The simplest case is that of a solid cylindrical conductor of radius r cms. carrying a steady current of C amperes with a resistivity at the working temperature of α ohms. The conductor is covered to a radius of R cms. with a solid insulating material closely fitting over which is a tube or cylindrical sheathing of lead or other metal. Calling ρ the electrical resistance of the conductor per centimetre of length, and S the thermal resistance of a body between two surfaces whose difference of temperature is ϑ deg. cent., we have:

$$C = \sqrt{\frac{\vartheta}{\rho S}}. \qquad (1)$$

This relation determines the limiting current strength for the cable when the radii and resistivity of the insulator are given, and the temperature elevation has been decided upon. The temperature elevation permissible for Siemens cable is 60 deg. C., and may be considered a fair limit and since the normal temperature of air or soil may reach 35 deg. C. in summer, the safe limit of temperature elevation will be 25 deg. C., or 45 deg. Fahr. with

this value of ϑ in equation (1), $C = \sqrt{\frac{5}{\rho S}}$ (2)

or developing $C = 5r\sqrt{\frac{2\pi^2}{\alpha \tau \log_e \frac{R}{r}}}$ (3)



where τ is the thermal resistivity and α the electrical resistivity in ohms.

This shows that if the thickness of the insulating cover maintained a constant ratio to the diameter of the conductor, the limiting current strength would be directly proportional to the radius that is to the square foot of the cross-sectional area of the conductor. In that case doubling the diameter of the wire would quadruple its cross-section, but only double the carrying capacity. It is evident, however, from an examination of the dimension tables for any kind of electrical cable, that the thickness of insulator does not usually increase in proportion to the diameter of the wire, and consequently the carrying capacity will generally increase faster than the radius and slower than the cross-section. For the standard Siemens cables it appears that quadrupling the cross-section of the conductor increases the carrying capacity about three times.

The author then takes up the case of buried cables and shows that they differ from that of cables submerged only in the fact that the external surface of the sheathing is not maintained at the normal temperature of the environment. The ground in fact interposes an additional thermal resistance to the flow of heat from the active conductor. Assuming that the cable lies buried at a uniform depth below the level of surface of the ground, the thermal resistance of the soil will for a given external cable diameter depend only upon the depth and upon the thermal resistivity of the soil. On this assumption then, the surfaces of heat flow are cylindrical, and the isothermal surfaces are also cylinders concentric to the conductor. A formula is given from which is obtained the curve above, indicating the thermal coefficient of resistance of the soil as dependent upon the depth at which a cable lies buried. The ordinates represent the thermal coefficient or $\frac{S}{B}$; the abscissæ, the depth of cable axis below the surface of the soil in radii, the radius being that of the completed cable or last covering.

From this curve it appears that at a depth of 50 radii a quadruple increase, that is, to 200 radii only, changes the resistance per centimetre of length from 0.7339 to 0.9549, an increase of about 30 per cent. The author also examines the influence of external layers of hemp or compound and that of neighboring active cables and gives a table and curve showing the latter. As regards the influence of duration of load upon temperature elevation, it would appear that under practical conditions, the temperature elevation in and near the cable tends to reach its maximum with comparative rapidity, the approximation to the final state being more tardy as the distance from the cable increases. In the measurements of the temperature elevation of buried samples, the elevation of sizes up to 200,000 circular mils (1,014 square cms) appeared to attain 95 per cent. of their full value in the conductor within 20 minutes, and the increase became inappreciable after one hour. On the other hand while as already remarked a parallel idle cable 11.4 diameters horizontally distant reached 38 per cent. of the active cable's sheath temperature, in three hours, out of 42 per cent. calculated, another idle cable at 22.8 diameters appeared to reach only 17 per cent. out of a calculated 29 per cent. in the same period, a discrepancy that may well have been due to time lag. It may therefore be safe to infer that the conductor of a buried cable will closely approximate to its ultimate temperature elevation in one hour of steady load, but there can be little doubt that many hours will be needed to establish an equal approximation to the final state at a distance of say 40 diameters from the cable.

The author concludes his paper by an examination of the condititions of a cable suspended in air.

In an appendix the author gives the computed safe carrying capacity of standard Siemens cables, insulated with jute soaked in special compound.

In reference to the table it was pointed out that additional carrying capacity of a cable when in water over that it possesses when in air, can seldom be availed of for the reason that a cable passing through water will usually have at least a short length in air or soil, which portion would become overheated if the length in water were worked to full capacity. For the buried cables, a temperature elevation of 12.50 degrees at the sheathing surface has been allowed.

1. Abstract of a Paper read before the Association of Edison Illuminating Companies, Chicago, Aug. 8th, 1893.

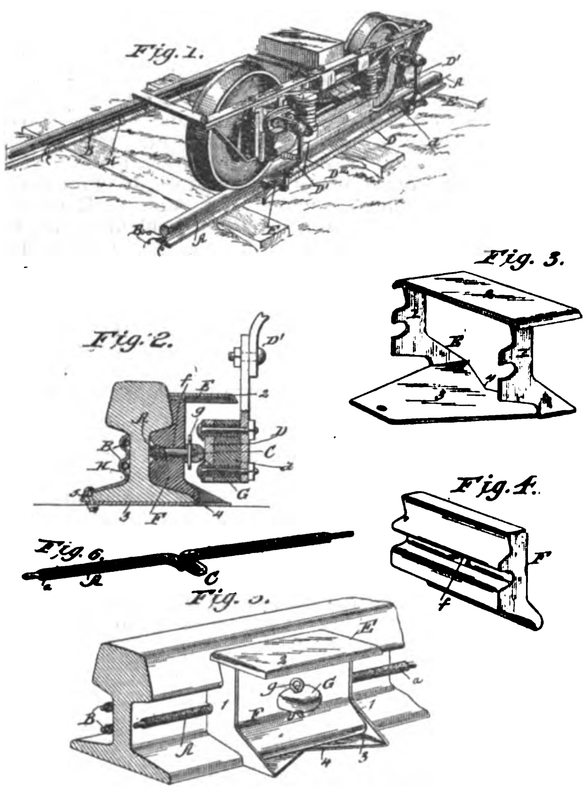
SOME EUROPEAN TELEPHONE STATISTICS.

THE *Economiste Français* has lately published some interesting particulars with regard to the progress in telephonic communications which has been made during the last eight or nine years by the principal countries of Europe. Commencing with 1883, the *Economiste Français* states that at the close of that year Belgium and Switzerland had more telephones than any other country. Twenty-three towns of Switzerland, with a total population of 447,877 inhabitants, had 3,579 subscribers, this being equivalent to one subscriber out of 125 inhabitants, the most remarkable feature being that several of the smallest towns were the best provided with telephones, Montreux, for instance, having a subscriber to every 31 inhabitants, while Geneva had only one in 832. Since then the increase has been so rapid that Switzerland now has nearly 10,000 miles of telephone wires with over 10,000 subscribers, who exchange about 8,000,000 communications in the course of the year. Belgium, in 1883, had telephones in six towns of a total population of 794,231 and 2,300 subscribers, this being equivalent to one in 345 inhabitants, whereas now there are about 12,000 miles of wires with about 6,000 subscribers, who exchange upwards of 10,000,000 messages. In Italy the telephone was limited to the six or seven principal cities, which, with a total population of two-and-a-half million inhabitants, had 7,269 subscribers. The increase, though large, has not been so rapid proportionately as in Switzerland and Belgium; but Germany, which had 5,838 subscribers in the 33 principal towns, has now about 70,000 miles of wire, with 49,531 subscribers exchanging about 257,000,000 communications. Denmark had only telephonic communication in Copenhagen, where there were 863 subscribers for a population of 350,000, and in Russia, where the telephone was confined to six or seven of the largest towns, there were only 2,000 subscribers, this being equivalent to one in 1,182 of their total population. The principal towns of Holland, with a total population of 805,544, had 1,718 subscribers, or one in 469 of the population; while in France there were 6,113 subscribers in towns the total population of which was rather over four millions. The progress in France since the State took over the telephones has been "very rapid," and there are now about 20,000 subscribers for the 112 towns which possess telephonic communication, this being exclusive of the telephones from town to town.

ELECTRIC RAILWAY DEPARTMENT.

THE JENKINS RAIL SIDE CONTACT ELECTRIC RAILWAY SYSTEM.

MR. W. F. JENKINS, of Richmond, Va., offers as a means of avoiding both the overhead trolley and the underground conduit electric railway methods, a system in which he places the feed



FIGS. 1, 2, 3, 4, 5 AND 6.—THE JENKINS RAIL SIDE CONTACT ELECTRIC RAILWAY SYSTEM.

wire in intimate relation with the rail, and picks up the current from it where bared by a contact device depending from the truck.

In the drawings Fig. 1 is a perspective view illustrating a section of track with car on it. Fig. 2 is a cross section of rail. Fig. 3 is a detail view of the clamping frame, and Fig. 4 of the insulating block. Fig. 5 is an enlarged perspective view of the wire, and Fig. 6 is a detail view of the feed wire and rail.

The feed wire A which may be termed the delivery feed wire to distinguish it from the supplemental feed wires B is arranged along the outer side of the rail, the wires B being on the opposite or inner side of the rail as shown. The feed wire A is of a special construction, being insulated throughout its main portion by a suitable insulating cover *a*, and is provided at intervals of say six or eight feet with bared contact portions C which project laterally for engagement by the brush or contact piece D upon the car. These contact portions C are usually provided by baring short lengths of the feed wire and looping or bending the same as shown. In connection with this feed wire A are clamps E by which to secure it firmly to the rail adjacent to its contact portion. This is an important feature, as by securing the insulated wire rigidly to the rail undue frictional wear is avoided that would result upon the insulated wire from vibration of the rail if such wire were loosely connected to the rail. Mr. Jenkins also uses an insulating block F apertured at *f* for the passage of the contact C and preserving the contact portion C in the desired position lateral to the rail. This contact portion C projects beyond the insulating block, and its extremity is protected by a removable cap G which fits on such extremity of the contact C and is suitably secured by the spring key *g* passed through perforations in the cap and through the loop of the contact. This removable cap receives all the frictional wear of the car contact brush or bar and avoids any wear of the feed wire; and as the aid caps are inexpensive and easily replaced when worn, it will be seen that they form an important feature, as they avoid the necessity of renewing or repairing the feed wire; which would result if the contact were borne directly thereby.

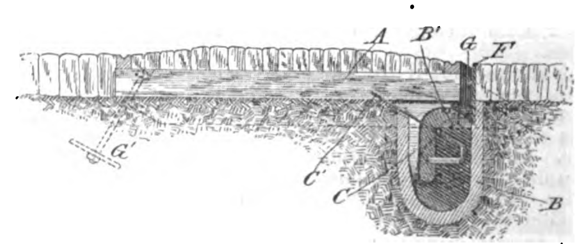
The clamps E are in the nature of frames fitting over the insulating blocks and having their side bars or plates (1) formed to bind the feed wire A firmly against the rail. At its top the frame E has a plate (2) which projects over and beyond the insulating block and operates as a shed to protect the block and contact from rain and the like.

The base plate (3) of the clamp frame is cut out centrally at 4, below the insulating block so that it will not retain water or snow at such point, and this base plate extends under the base of the rail and is secured. By preference the plate 3 extends below the rail and to or nearly to the outer edge of its base plate where it is secured by a bolt or rivet at 5, the same bolt or rivet serving to secure the clamp plate H which operates to hold the supplemental feed wires B to the inner side of the rail.

The brush or contact piece D is formed to extend between two of the feed wire contacts so that it is always in touch with one of the contacts, and is supported on arms D′ from which it is insulated at *d*, the arms being connected by ball and socket joints with the car truck so that the brush can follow the rail in rounding curves and the like, the arms D′ being also connected with the truck by springs in order to hold the brush to the points of contact. A wire D² leads from the brush to the motor.

THE JOHNSON ELECTRIC RAILWAY CONDUIT.

EFFORTS are continually being made to simplify, cheapen and render operative systems of electric railway conduits, and one of the latest plans is that proposed by Mr. Isaac La Rue Johnson, of Washington, D. C., as illustrated in the sketch herewith. In the drawing, A represents a cross tie of the roadway with which his subway is connected, B, the subway or conduit, C, the pendant for the support of the bracket D; F, the guard plate which forms one of the walls of the trolley slot G, the opposite wall being formed by the road rail adjacent thereto. The subway proper is semi-cylindrical in cross section, and has its walls extended in parallel planes to any desired height consistent with the requirements of the case, though it may be made very shallow. The ties have their ends on that side of the road, overhanging the subway, and at suitable intervals the pendants are attached to the sides thereof. In the cut they are shown as bolted to the tie and at the same time partly embedded in the material of which the subway is composed. This is done for the purpose of securing greater solidity in the entire structure. This pendent is of any suitable material, such as iron, wood, glass, rubber, or indurated fibre, the last being preferred as it possesses the requisites of non-conductivity, strength, lightness and durability. The bracket D



THE JOHNSON RAILWAY CONDUIT.

may also be of any desirable form and material which will afford the best results in regard to non-conducting qualities, and other requisites, and upon this the conductor is to be secured in any ordinary manner.

MORE FIGHTING OVER ELECTRIC CAR TRACKS.

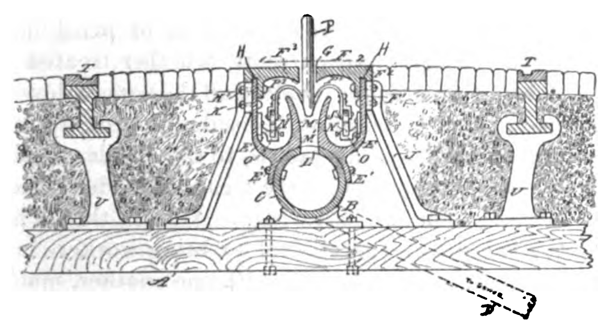
LAST week we chronicled the fighting at North Abington, Mass., over the electric street car tracks crossing the tracks of the New York, New Haven & Hartford Railroad. This week we have to record fighting at Gilberton, Pa., over the tracks of the Schuylkill Traction Company. It is said that the Traction Company had been carrying matters with a rather high hand, and the tearing up of its tracks precipitated a row which ended only when a couple of men had been shot dead and others wounded. This little unpleasantness is likely to be regarded in prejudiced quarters as another proof of the deadliness of the trolley.

ZELL'S ELECTRIC RAILWAY CONDUIT WITH CONTINUOUS DRAIN PIPE.

One of the obvious difficulties connected with electric railway conduits is that of drainage, it being evident that the drier the conduit is the more remote is the danger of current leakage or short circuit. Mr. Robert R. Zell, of Baltimore, has recently patented a form of railway conduit here illustrated, in which a continuous, slotted drain pipe is a main feature of the method for metallic circuit operation.

Upon the ties A located under the bed of the street, there is secured a saddle B which extends the entire length of the roadbed. Upon the the said saddle there rests a drain pipe C which also extends the entire length of the road. A pipe D, shown in dotted lines leads from the said drain pipe to a sewer. Upon the top of the said drain pipe there are secured castings E on each side by bolts E'. Upon the upper edge of the said castings a slot rail F is placed having a central opening G and vertical depending flanges F' and F² between which the upper edge of the said castings is placed, and in order to prevent the water from working from the earth through the connection between the said rail and castings, is placed felt H in the upper edge of the said castings, as shown in the drawings. At suitable distances apart, cast iron brackets J are secured to the ties and extend upwardly against the sides of the said castings E and are secured thereto by bolts K-K', the bolts K' also passing through the flanges F' of the slot rail F so as to hold all the parts in proper position.

The upper part of the drain pipe C has perforations L prefer



The Zell Railway Conduit and Drain.

ably oblong in shape and on the sides of the perforations extend upwardly the deflectors M forming part of the castings E, for the purpose of deflecting the water which might enter the opening G in the slot rail F, running down into the drain pipe C and from there to the sewer by which means the water is prevented from coming in contact with the copper rods N-N'. These rods are supported upon insulating brackets O. It will be seen that the slot rails F at the central opening G are extended downwardly to points F³, the purpose of which is to prevent the water running along the under side of the slot rails, passing down, and coming in contact with the trolley rods; but by bringing the slot rails to points, as shown, the water runs to the points and drips down through the funnel M' formed by the deflectors M, into the drain pipe C.

The trolley P is rectangular in shape, as shown, and at its lower end has two branch arms P' and P², to the former of which the positive current passes from the copper rod N up to and through the right-hand portion P³ of the vertical trolley frame and to the motor and after passing through the motor passes down the left-hand portion P⁴ of the trolley frame to the arm P², and then to the return copper wire N'.

SOME INTERESTING STATISTICS OF THE LIVERPOOL OVERHEAD ELECTRIC RAILWAY.

It will be remembered that early in the present year we illustrated and described the new electric elevated road at Liverpool, England. The company has just held its first half-yearly meeting, when some very interesting and encouraging statistics were given by the Chairman, Sir W. B. Forwood. Very rarely indeed has an undertaking of such magnitude, involving so many considerations of the highest scientific importance, been so successfully inaugurated. From the first week after the railway was opened for public traffic they had maintained a regular and reliable quick service of trains, and to-day, although they are running a five minutes' service, 94 per cent. of the trains are on time, and of the remaining 6 per cent., 3 per cent. are irregular only to the extent of a few seconds. For this excellent result they were indebted to the skill of the engineers, Sir Douglas Fox and Mr. Greathead; the good work given to them by the contractors; and last, though by no means least, the attention and care of their general manager and engineer, Mr. W. Cotterell.

The accounts presented embraced a period of rather more than 16 weeks. They carried during that period 1,370,742 passengers, or at the rate of 4,300,000 per annum. It is estimated that the penny omnibuses at present running in competition with the railway are carrying at the rate of 2,000,000 passengers per annum, thus making the traffic already developed along the line of docks over 6,000,000 passengers per annum; and this during a time of great commercial depression, when the shipping trade of the port of Liverpool has been paralyzed. This depression has affected the railway in a curious way. Usually the roadway fringing the docks is so blocked with carts and lorries conveying merchandise as to make quick vehicular traffic impossible. At present the goods traffic is so light that the omnibuses have been able to make very fair running time. The overhead road is every day developing new sources of traffic. A ride up in the Electric Overhead Railway has become an important item to the programme of every well-conducted excursion; and although the present northern terminus is nearly a mile away from the Seaforth shore, they carry large numbers destined for Seaforth. This induced the directors to expect a large increase of traffic on completion of the northern extension. Electrical traction, combined with automatic electric signals and lighting, should make a very cheaply worked line, and they believed that when they take the electrical generating station into their own hands, they will effect a considerable saving. The result of 16 weeks' working has been that, after paying all working expenses, rates and taxes, and general charges, there is a balance to the credit of the net revenue account of £5,361 15s. Deducting from this interest on debentures and the dividend due on preference capital, left a balance of £3,293 9s. This is equal to about 2¼ per cent. on the ordinary capital for the time at work. The amount of share capital issued is £450,000, and of debenture stock £125,000. This the directors estimated would complete the railway, including the northern extension to Seaforth, but they have to provide about £11,(00 to settle the contractors' bill of extras, and a further amount for new stations. In the overhead railway they had a very valuable property, with a sure and rapidly progressive future. There had been many in Liverpool who were sceptical as to the extent of the traffic, and the estimate put forward in the prospectus of 5.000,000 passengers per annum was deemed extravagant. They had only been running for four months, yet they saw a total traffic developed of over 6,000,000 per annum. It is the old, old story, give rapid, frequent and cheap means of travel through a populous place and one cannot fail to create an unlooked-for and unexpected amount of travel.

After the dividend on the preference shares at the rate of 5 per cent. per annum had been voted, the chairman referred to various extensions proposed, and said that he did not think they could or would be long delayed.

THE CITY AND SOUTH LONDON AND LIVERPOOL OVERHEAD RAILWAYS.

The following comparative figures with regard to the City and South London and Liverpool overhead railways may be of interest says the London *Electrician*. It is to be observed, however, in connection with the locomotive and generating expenses per train mile that whilst on the London line the trains consist of three cars and a locomotive, at Liverpool each train consists of only two motor cars; at Liverpool, moreover, the trains are run under a contract with the Electric Construction Company. The figures for total capital expenditure, capital expenditure per mile of line open, and passengers carried, are given in round numbers:

	City and South London Railway	Liverpool Overhead Railway.
Length of line open..........................	3⅛ miles	5⅛ miles
Total capital expended on line open.........	£878,000	£528,000
Capital expenditure per mile of line open....	£280,000	£103,000
Present rate of passenger traffic per annum..	6¼ mill.	4⅛ mill.
"Loco" and generating expen's per train mile	6.48d.	4d.
Passenger earnings per train mile run.......	24.7d.	26.6d.

TAPPING ELECTRIC RAILWAY FEED WIRE.

Two boys were arrested at Lansingburgh, N. Y., last week, on a charge of tapping the feed wire of the Troy City Railway Company, in that village. The complaint was made by President Cleminshaw. The purpose of tapping the wire, the accused said, was for amusement, but the railway company officials think that it was for deliberate theft of current. The discovery was made by one of the linemen, who was inspecting the feed wires which are used to supply divisions in Troy and Lansingburgh. He found one of the wires had been cut and taken about 200 feet to a barn near Judson's coal office, where a good connection was made by putting a piece of gas pipe into the ground and attaching another piece of wire to it. The offense is a serious one, as there is a provision in the statutes for the punishment of such offenders.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* The Electrical Engineer. *Communications for the attention of the editors should be addressed,* Editor of The Electrical Engineer, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

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THE WORK OF THE ELECTRICAL CONGRESS.

THE electrical event of 1893 is now a thing of the past and the expectations with which it was awaited and the hopes which were built upon it, must in the main be considered to have been realized. No one who is not directly concerned in the actual work of organizing and getting together an assemblage of this nature can form an adequate idea of the amount of work and time required to bring about the results achieved at Chicago. This applies more particularly to the Chamber of Delegates which included representatives from no less than twelve governments. The importance of the work which they have accomplished cannot be overestimated. Even if some of their recommendations should not meet the views of all who have devoted their attention to the subjects of electrical units and nomenclature, the establishment of official standards and names recognized and employed the world over by electricians will be a powerful aid to progress in scientific as well as in purely practical work. But while the delegates themselves have decided on these important points, the fact must not be lost sight of, that, at least, so far as most foreign countries are concerned, the final ratification of the governments themselves is necessary. On this point, however, we believe little is to be feared, as the character of the Chamber of Delegates was such as to entitle its dicta to the fullest acquiescence.

The papers presented in the working sections of the Congress covered nearly the entire field of applied electricity and both in quantity and quality compare very favorably with those presented at previous Congresses. It is to be regretted however, that the division of the Congress into Sections on Pure Theory, Theory and Practice, and Pure Practice, though intended to economize time and to bring together those interested in special subjects, did not fully succeed. Although there was nothing to prevent the formation of sub-sections, the result proved that many of those more especially interested in papers on dynamo and transformer work were compelled to listen to others, or miss the opportunity of hearing and taking part in the discussions. But on the other hand, it may be urged, and not without justification, that all the present applications of electricity are so closely interwoven and overlap one another to such an extent, that the advances made in one department almost invariably have a corresponding influence in others. This influence was particularly noticeable in the papers read before the Congress, a most striking example being afforded by the valuable paper of Prof. S. P. Thompson on "Ocean Telephony," which, as he himself states, is the direct outcome of work and results accomplished in the heavier branches of alternating current work. Looking over the titles one cannot but be struck by the great predominance of those devoted to or involving the application of alternating currents, whether treated of as pure theory or as practice. Indeed all the papers devoted to pure theory were based on the consideration of alternating current phenomena. This fact is, to say the least, significant and points out strongly the trend of modern thought and investigation in electricity. While the Chicago Congress has done a great deal to bring workers in electricity into harmony and touch with one another, much still remains to be done and it would hardly be hazarding too much to express the opinion that the next Congress will find enough work ready for it. At the present rate of progress the date of such a gathering cannot be very remote and even if the more important questions of units and nomenclature should not occupy the prominent position which they did in the Congress just closed they will still bear discussion and exemplification; while the more immediate, practical development will afford sufficient matter of a nature to attract electricians. We cannot close these remarks without paying a just tribute to the untiring work of the organizers of the Chicago Congress, at the head of whom stands Dr. Elisha Gray, and to the intelligent and hearty co-operation of the American Institute of Electrical Engineers.

OCEAN TELEPHONY.

THERE was probably no paper read at the Congress which attracted more attention or gave rise to a more spirited discussion than that of Professor S. P. Thompson on "Ocean Telephony." It was fortunate that among the attending members were many from at home and abroad familiar with the problems met with in submarine telegraphy, and they did not allow the opportunity to go by without recording their views on the subject. Ocean telephony is one of the dreams of the electrician, and at one time few but dreamers dared hint at the possibility of its accomplishment. Certainly Prof. Thompson is no dreamer, and anything that he may have to say on an electrical subject is worthy of serious consideration. It is, perhaps, to be regretted that the solution which he has offered in the paper appearing elsewhere in this issue did not meet with the approval

of any of those who discussed the paper. On the one hand, the cable makers saw the great difficulty encountered in the increased cost of such a cable, while the working electricians had doubts as to the correctness of the principle involved, and saw difficulties ahead in the location of faults, when trouble appeared, as it must inevitably do in practice. Prof. Thompson's contention that if his theory be correct, it is the business of the cable engineer to make his plan practical seems to us to be in the nature of begging the question. Where the investment of capital required to carry out a trial of this nature, is so great, both the capitalist and the engineer must see their way clearly. The experiments on an artificial cable, especially in a matter of this nature can, we think, be scarcely considered as conclusive. The fact alluded to by Prof. Cross, that of the current observed to enter the telephone line at New York, but one per cent. was accounted for at the Boston end of the line, is a most significant fact when considered in connection with telephonic cable transmission. Whether or not, more powerful transmitters than are now employed can be constructed without destroying the clearness of transmission must also be a matter of first consideration in cable telephony. We admire the pluck of Prof. Thompson in bringing forward a plan which he must have known would meet with the opposition of probably everyone able to discuss the subject intelligently. Even if no one can be found to try the experiment on a practical scale—which we hope will not turn out to be the case—he has nevertheless, given electricians something to think about, and this may, perhaps, lead to a more acceptable and feasible plan in the future.

A ONE HUNDRED HOUR ARC LAMP.

With the exception of a few minor improvements in the arc lamp mechanism, looking towards the steadying of the arc, there has been practically no change or advance in the art since its first practical exploitation some fifteen years ago. The frequent renewal of the carbons, though early recognized as the most serious drawback in this otherwise unsurpassed method of illumination, is still a necessity, notwithstanding the many attempts which have been made to overcome this disadvantage. It would seem, however, that we are now placed in possession of a method which is deserving of the most serious consideration by all interested in arc lighting, and the paper read by Mr. L. B. Marks before the Electrical Congress contains a large amount of data on the new device. Perhaps the principal merit of the plan outlined by Mr. Marks is to be found in its simplicity and its ready applicability to existing arc lamps, for it is safe to say that it would require more than ordinary superiority in any apparatus to warrant its introduction to the discarding of older, well-tried mechanism. In this respect, therefore, nothing seems to stand in the way of its introduction. The reduced expense in trimming arc lamps, let alone the saving in cost of carbons, which would be effected by a lamp burning continuously for one hundred hours, must appeal to every central station manager. There is also another aspect to the question which was not touched on in the discussion of Mr. Marks' paper before the Congress, and that is the probable increase in interior arc lighting which will follow the introduction of a successful 100-hour arc lamp. Already arc lamps of 100 to 200 candle power have come into use to quite some extent abroad, especially in Germany, and it is not difficult to discern the extent to which the arc lamp of small candle power, using scarcely more than two or three amperes can be applied, once its practicability is demonstrated in connection with a device which will require no attention to be given to the lamp for a week or two at a time. We hope that a trial on a practical commercial scale of the new Howard device will be made at an early date. Its importance to the future of the electric lighting industry cannot be overestimated.

THE BANQUET GIVEN THE FOREIGN OFFICIAL DELEGATES TO THE ELECTRICAL CONGRESS.

On the evening of Thursday, August 24th, a banquet was given by the American members of the Congress to the foreign official delegates, at the Grand Pacific Hotel, Chicago. Dr. Elisha Gray acted as chairman and toast master.

When the coffee and cigars had been brought on, Dr. Gray arose and in calling the members present to order, said that the assemblage which he saw before him recalled to his mind strongly the days of old when Mr. Summers brought over from England the first rheostat and differential galvanometer and the havoc which their use played with the telegraph lines then in use. After other numerous witty and well-timed remarks, Dr. Gray introduced his excellency Professor Von Helmholtz.

Professor Helmholtz, in reply, said that he rejoiced in the success evident on all sides in electrical work here in America, just as a father rejoices in the success of his children. Europe presented a somewhat limited field for action and enterprise, and still suffered from the wounds of the past, but America had done a great work inside of a century. It had blended all the intelligence of the Aryan race, the predominant one all the world over. Its conditions were extremely favorable and with fuller means of existence and development, the limit of its progress was not in sight. He concluded by drinking the health of "The Great American Nation."

Dr. Gray then proposed the health of the foreign Delegates, which was responded to by Mr. Preece, Professor Mascart and Professor Ferraris in their native tongues.

Mr. Preece in well-chosen words, interspersed with witty allusions, spoke of the great hospitality with which the foreign delegates had been received on all sides, and he thanked the American members for it most heartily. Nature, he said, had distributed her energy badly, and had given us more than our due share apparently. As on former occasions, when visiting this country, he would return a better, a wiser and a more energetic man, and he welcomed all American electricians to England. Prof. Mascart echoed Mr. Preece's sentiments, and referred particularly to the great harmony and courtesy which existed throughout the deliberations of the Chamber of Delegates. He paid a special tribute to Professor Mendenhall, through whose intelligent efforts the deliberations of the Chamber of Delegates were kept so well confined to the subject in hand. He expressed the hope that all nations would accept the recommendation of the Congress. In referring to the activity in America and that at home, he thought he could find no better analogy than by comparing them, respectively, to the speeds of the elevators in Chicago and those abroad. Professor Ferraris followed in a similar strain in Italian, and his remarks concluded the official speeches.

Professor Ayrton being called upon, said that he had made a discovery. He had always known that Americans were a go-ahead people, but he had now learned that they were full of loving kindness. C. G. S. would, henceforth, also stand for "Chicago Good Society," and would be expressed by ten raised to the power of infinity. He might also define his experiences here in a symbol embodying an unvarying good time under a pressure of good entertainment. Heretofore, the symbol "A. H." had stood for ampere hour; in future it would have to stand for "American Hospitality." He concluded by proposing the health of The American Electrical Engineers. The toast "The American Institute of Electrical Engineers" was responded to by Professor E. J. Houston, president of the Institute, who expressed his satisfaction that that body had been able to welcome so many to Chicago.

Prof. S. P. Thompson being called upon, remarked that he would always be haunted by the memories of Chicago. America is not only annexing the ideas of foreigners, but the foreigners themselves, and he referred to Messrs. Lockwood, Kennelly, Forbes and others as such examples. After some humorous remarks on the flood of new units which threatened to deluge us, he thought that America might soon be known as the "Unit"-ed States. He

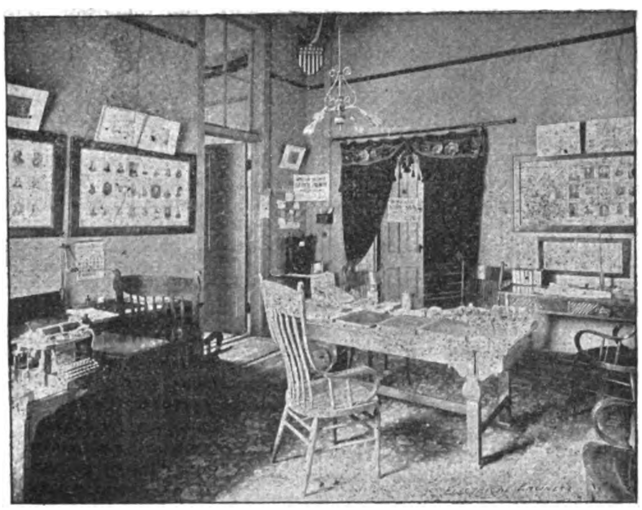
proposed the health of Prof. Mendenhall, who replied briefly. Dr. Budde toasted the "City of Chicago."

Mr. Preece proposed the health of Mr Edison, who was present, and who was greeted with applause lasting for several minutes. Mr. Edison, although called upon for a speech from all sides, followed his usual custom, and merely bowed his acknowledgements.

Prof. Carhart described the scene in the Chamber of Delegates when the "henry" was formally adopted. Notwithstanding the adoption of the "quadrant" at Paris in 1889, the French Delegates proposed and seconded the new name, which was unanimously adopted. It was a marked exhibition of courtesy, and one which had made an indelible impression upon his mind. Remarks were also made by Prof. Elihu Thomson and Mr. T. D. Lockwood. This most enjoyable occasion was brought to a close by Dr. Gray, who bade the visitors farewell.

AN ENJOYABLE EPISODE OF THE CONGRESS.

Before the adjournment of the sections of the Electrical Congress on Wednesday an invitation from Lieut. Spencer, of the General Electric Company, was announced to all members to join in an afternoon of enjoyment and sight-seeing at Jackson Park. Nearly all present were glad to accept and the party mustered, under Lieut. Spencer's leadership, on board the "whaleback" steamer "Christopher Columbus" at 1.45 p. m. Thirty minutes on the lake brought into view the marvelous structures on the Fair grounds, giving all on board one of the most striking views of the exterior of the Exposition attainable. From the steamer the



American Institute of Electrical Engineers Headquarters, Electricity Building.

visitors were conducted to the endless traveling "sidewalk" where all could step on, sit down and ride out and back over the long pier. We cannot undertake to describe all of the afternoon and evening pleasures, nor suitably acknowledge the many attentions and courtesies bestowed by exhibitors and others. Lieut. Spencer seemed to be everywhere, and there was apparent a subtle community of purpose and disposition between him and the various proprietors and representatives who were visited, to leave nothing undone for the satisfaction of the guests.

The German building, containing the Krupp exhibit was visited. Here the courtesy extended went so far as to the temporary exclusion of the general public while the members of the Congress made their inspection. A visit to the West Point Cadets' Encampment was next in order. Here so potent were the influences at work to prevent any disappointment that the evening parade was deferred nearly half an hour until all the visiting party had assembled.

After supper and the informal meeting and reception of the American Institute of Electrical Engineers at its Worlds' Fair headquarters, Lieut. Spencer again took command and soon embarked all hands on some half dozen launches of the Electric Launch and Navigation Company. Commodore Barney in charge of the fleet of launches gracefully represented his company, and boarding the leading boat conducted the flotilla through the lagoons and waterways to the Midway. A promenade down the Midway brought the party to the Ferris Wheel. Mr. Ferris received the visitors most cordially. To his courtesy all the members of the congress who were present owe the recollection of a most novel and interesting experience. Twice around the big wheel affords sensations of strangeness and a view of the Fair grounds at night that cannot be soon forgotten. The last guest emerged from the wheel at 10 o'clock. Many of the company thought this the close of the programme, but more was in store. It had seemed to Mr. W. R. Brixey, of New York, that something in the way of refreshment would be in order about this time; so all—except the unfortunate few who had gone untimely—were directed to the Deutches Dorf where were found long tables with ample luncheon and no end of excellent beer, quite the thing for a hot night at the Midway. Nearly two hours were spent in good fellowship and the enjoyment of Mr. Brixey's hospitality.

A DAY OF PLEASURE AFTER THE CONGRESS.

Saturday, August 26, was largely given up to joint excursions and pleasure trips by the members of the Congress, many of whom remained to see the Fair after their five days' labor. They assembled therefore at the exhibit of the American Bell Telephone Company in Electricity Building in the early afternoon, and witnessed tests of long distance lines, exchange service and experiments with the radiophone. The Western Electric Co. then took the party in hand, and the president, Mr. E. M. Barton, assisted by Mr. W. R. Patterson, took the visitors through their extensive and varied exhibit, including the Scenic Theatre. The latter exemplified light effects of a quality seldom seen in theatres.

The exhibit of Gray's perfected Telautograph was next visited, and this ingenious apparatus proved extremely interesting to many who had not seen it before.

At five o'clock a reception was given by Mr. W. H. Preece, president of the English Institution of Electrical Engineers, at Victoria House, the headquarters of the British Commission. Here English good cheer was dispensed to a delighted company, who improved the occasion for a more extended fraternization than had been possible during the busy days of the Congress.

At 7 p. m. the exhibit of the General Electric Co., throughout its various departments, was inspected under the guidance of Lieut. Spencer and his assistants. Next came a visit to the exhibit of the Westinghouse Electric and Manufacturing Co., where every opportunity was afforded for the examination of some of the most striking features of Electricity Building. Through the courtesy of the Department of Electricity, a collation was then served to members of the Congress at 10 p. m. in Electricity Building, when all present had another exemplification of World's Fair hospitality.

The evening was also interspersed with other engagements and courtesies. At 8.30 the members of the Chamber of Delegates were invited to ride on the huge Ferris wheel; while the Libbey Glass Co. and the Electric Scenic Theatre honored the Congress badges throughout the day.

A CONGRESS PARTY AT NIAGARA.

The New York delegation leaving on Saturday, Aug. 19, for the Congress, had a very pleasant trip over the electric railway on the Canadian shore of the Niagara Falls, recently described in these columns. The party were met on Sunday morning by Mr. W. A. Grant, manager of the Niagara Falls Park and River Railway, and Mr. W. Rutherford, electrical engineer of the Canadian General Electric Company, and were carried from one end of the line to the other in a special car. The trip was highly successful and was very much enjoyed, the views from the road exceeding all expectations.

The party consisted of Mr. and Mrs. C. O. Baker, Jr., Mr. and Mrs. McIntire, H. A. Reed, Miss Reed and Mr. Reed, Jr., C. P. Steinmetz, J. A. Pentz, Julian Moses, G. M. Phelps, H. Lemp, Jr., Capt. de Khotinsky, H. H. Fairbanks, H. L. Shippy, E. A. Colby, Prof. W. Lispenard Robb, Prof. A. Jamieson, C. Cuttriss, S. D. Field, and C. O. Mailloux.

REPORTING THE CONGRESS.

The work of reporting the Congress was very much facilitated by the careful and intelligent work of Prof. F. B. Crocker, who was appointed its permanent secretary. His assistance was greatly appreciated by all members of the press, who found him at all times ready to lighten their labors, no matter how much in so doing he might increase his own. We may add that only part of the stenographer's report has reached New York in time for this issue.

A RECEPTION TO PROF. VON HELMHOLTZ.

There were various private festivities during the week in Chicago in connection with the Electrical Congress. The most striking and interesting of these was the reception given on Friday night to Prof. von Helmholtz at the residence of Mr. O. W. Meysenberg, of the Siemens & Halske Electric Co. of America. It was a brilliant affair, and was very largely attended.

THE INTERNATIONAL ELECTRICAL CONGRESS.

Gray.

THE International Electrical Congress was opened in Columbus Hall, at the Art Institute, Chicago, Aug. 21, in the presence of over 500 delegates and others. The platform was occupied by the delegates appointed by the United States and foreign governments; PROF. VON HELMHOLTZ occupying the seat of honor and his appearance being greeted with great applause.

DR. ELISHA GRAY opened the Congress with fitting remarks and on motion of Mr. W. H. PREECE, PROF. ELIHU THOMSON was elected temporary chairman. In thanking the members for the honor conferred upon him, Prof. Thomson expressed the opinion that the Exposition as it stood to-day would have been impossible without the aid of electricity.

PROF. F. B. CROCKER was then elected temporary chairman of the Congress, and a committee was appointed by the chairman to nominate permanent officers.

Helmholtz.

While this committee was deliberating, the chairman called upon PROF. W. E. AYRTON, who addressed the members on the impressions which his visit had made upon him. In order to judge fairly of what he had seen he had to divest himself of all prejudices. When one saw the incandescent lamps in isolated houses, arc lamps in country lanes, and electric railways everywhere, one felt that no Board of Trade was necessary to regulate affairs. But, on the other hand, when one beheld the condition of wires and pole lines, the transformers stuck on the walls of houses, etc., one sighed for some such body as the Board of Trade. The Lynn, Schenectady and Pittsburgh factories were marvels, and above all the courtesy shown was beyond expression. Coming to the electrical exhibit at the Fair, Prof. Aryton remarked that if we were to take a person into Electricity Building blindfolded, so that he could see nothing of the grandeur of the exterior of the buildings and then remove the bandage from his eyes, the electrical display would be disappointing. So far as the foreign exhibits were concerned they were scarcely represented. England's display in particular was very meagre. Even the American display did not do America justice; the real electrical display of America was not to be sought in Electricity Building, but in every town and village where there are electric lamps and railways. At Jackson Park it was not what was inside, but outside of Electricity Building that told the story of electrical progress; the nation that could create such an exhibition must have a marked influence on the progress of humanity. He thought that perhaps the most striking exhibit of all was the young electricians whom he saw everywhere in this country entrusted with responsible work. Prof. Aryton closed by remarking that as one grew older, age, like self-induction, smoothed out the little ripples in the curve of life; but he would always remember the peak in his curve representing "Chicago, 1893." Prof. Ayrton's remarks were listened to with close attention and greeted with great applause at their close.

Preece.

Ferraris.

The committee on permanent officers through Prof. Mendenhall, chairman, then reported the following names, and all those nominated were elected unanimously, as follows:

Honorary President: Prof. H. von Helmholtz.

Chairman: Dr. Elisha Gray.

Vice-Presidents: Edward Weston, United States; W. H. Preece, Great Britain; Prof. E. Mascart, France; Prof. Voit, Germany; Dr. Johann Sahulka, Austria; Prof. G. Ferraris, Italy; Prof. H. F. Weber, Switzerland.

Permanent Secretary: Prof. F. B. Crocker.

Mascart.

PROF. HELMHOLTZ was then introduced and traced briefly the remarkable changes and great progress which the science of electricity and its applications had undergone since he first took up its study nearly half a century ago.

DR. GRAY then assumed the chair and introduced MR. W. H. PREECE who expressed great hopes for the success of the Congress of 1893, which, if all indications did not fail bade fair to be a memorable one in the annals of electricity.

PROF. MASCART, being called upon, said that the work so well begun by the British Association and so greatly fostered by the efforts of Lord Kelvin, would here find its fitting consummation, and he hoped that units and standards would be adopted that would be recognized the world over.

PROF. T. C. MENDENHALL then made a number of announcements and invitations were read from the Long Distance Telephone Company and the General Electric Company, extending courtesies to the members of the Congress.

The meeting then adjourned.

Thomson.

ON Tuesday morning, Aug. 22, the three sections into which the congress was divided met in Halls VI., VII. and VIII., of the Art Institute, and proceeded to regular organization and business.

Section A, to whom was committed the department of Pure Theory, met in Room VI., and was called to order at 10 o'clock a. m., by Prof. H. A. Rowland, of Johns Hopkins University, and the following officers were nominated and unanimously elected: *Chairman*, Prof. H. A. Rowland, of Johns Hopkins University; *Vice-Chairman*, Prof. Galileo Ferraris, of Italy; *Secretary*, Prof. A. L. Kimball, of Amherst College; *Sectional Committee*, Prof. A. G. Webster, of Clarke University; Alexander Macfarlane of the University of Texas; Charles P. Steinmetz, of Yonkers, N. Y.

Weston.

A permanent organization being effected, chairman Rowland introduced Prof. Ferraris who addressed the section briefly and dwelt on the intimate connection between theory and practice in all the applications of electricity, and especially so in America. Owing to the absence of blackboards the section adjourned for the day.

Section B, was opened by Prof. Charles R. Cross, who appointed a committee to nominate candidates for permanent officers. The nominating committee reported the names of the following gentlemen who were unanimously elected: *Chairman*, Prof. C. R. Cross; *Secretary*, Lieut. Reber; *Executive Member*, Prof. A. E. Dolbear. The reading of papers was then proceeded with.

Section C was called to order by Prof. Edwin J. Houston, the temporary chairman, who appointed a committee to nominate permanent officers of the Section.

Ayrton.

The committee reported the names of the following gentlemen who were unanimously elected: *Chairman*, Prof. Edwin J. Houston; *Vice-Chairman*, George P. Low; *Secretary*, Prof. E. P. Roberts; *Sectional Committee of Three*, George W. Blodgett, Dr. F. A. C. Perrine and Townsend Wolcott.

In assuming the chair Prof. Houston thanked the Section for the honor conferred on him, and in the course of his remarks, observed that unfortunately he did not quite understand the reason for the division of the Congress in Sections on Pure Theory, Theory and Practice, and Pure Practice, and thought it rather unfortunate that there should have been an attempt made to draw this sharp divisional line. To his mind no such differences in reality exist. Perhaps it might have been better to have divided the vast field of electrical science into sections embracing specific topics. Theory and practice should be wedded, not divorced.

The Chairman also called upon Messrs. Geo. P. Low, E. P.

Roberts, Jos. Wetzler, Prof. D. C. Jackson, Dr. F. A. C. Perrine, Capt. de Khotinski, Dr. Bohm and Mr. C. C. Haskins, who addressed brief remarks to the Section. The reading of papers was then proceeded with.

The following papers were accepted by the Committee on Programme and assigned to the several sections as indicated, where they were read and discussed :

Section A.—"On the Analytical Treatment of Alternating Currents," Prof. A. Macfarlane; "Complex Quantities and their Application in Electrical Engineering," Charles P. Steinmetz; "General Discussion of the Current Flow in Two Mutually Related Circuits Containing Capacity," Dr. Frederick Bedell and Dr. Albert C. Crehore; "Explanation of the Ferranti Phenomenon," Dr. J. Sahulka; "Measuring the Power of Polyphase Currents," A. Blondel; "Extended Use of the Name Resistance in Alternate Current Problems," Prof. W. E. Ayrton, F. R. S.

Section B.—"Signaling through Space by Means of Electromagnetic Vibrations," W. H. Preece, F. R. S.; "Materials for Standards of Resistance and their Construction," Dr. S. Lindeck; "Variation of P. D. of the Electric Arc, with Current, Size of Carbons and Distance Apart," Prof. W. E. Ayrton, F. R. S.; "Ocean Telephony," Dr. Silvanus P. Thompson; "Iron for Transformers from the Magnetic Point of View," Prof. J. A. Ewing, F. R. S.; "Note on Photometric Measurement," Prof. B. F. Thomas; "Some Measurements of the Temperature Variation in the Electrical Resistance of a Sample of Copper," A. E. Kennelly; "Various Uses of the Electrostatic Voltmeter," Dr. J. Sahulka; "On a Method of Governing an Electric Motor for Chronographic Purposes," Prof. A. G. Webster; "On the Construction of Cables for Subterranean High Tension Circuits," Dr. A. Palaz; "Periodic Variation of the Candle Power of Alternating Arc Lights," Prof. B. F. Thomas; "Transformer Diagram Experimentally Determined," Dr. Frederick Bedell; "London Electrical Engineering Laboratories," Prof. Andrew Jamieson; "On the Source and Effects of Harmonics in Alternating Circuits," Prof. H. A. Rowland; "A Pair of Electrostatic Voltmeters," Prof. H. S. Carhart; "On the Maximum Efficiency of Arc Lamps with Constant Number of Watts," Prof. H. S. Carhart; "On Direct Current Dynamos of Very High Potential," Prof. F. B. Crocker; "On an Improved Instrument for Measuring Magnetic Reluctance," A. E. Kennelly; "The Swinburne-Thompson Unit of Light," Dr. Silvanus P. Thompson, F. R. S.

Section C.—"Rotary Mercurial Air Pumps," F. Schulze-Berge; "A Hundred-Hour Electric Arc Light," L. B. Marks; "The Conversion of Alternating into Continuous Currents," Dr. C. Pollak; "The Use of Accumulators in Central Stations," Dr. C. Pollak; "Underground Electric Construction in the United States," Prof. D. C. Jackson; "A New Incandescent Arc Light," L. B. Marks.

The following is a list of those in attendance :—

Brown Ayres, Albert B. Allen, L. J. Auerbacker, Geo. L. Anderson, W. S. Aldrich, E. A. Armstrong, W. A. Anthony, B. J. Arnold, A. V. Abbott, C. G. Armstrong, N. Amundsen, W. E. Anderson, W. E. Ayrton, J. I. Ayer.

De Witt B. Brace, F. Bathurst, Jas. G. Biddle, J. P. Barrett, J. O. Bayliss, E. C. Bradley, F. B. Badt, H. Bergholtz, L. K. Bohm, E. W. Blake, C. O. Baker, Jr., C. S. Bradley, A. E. Braddell, Major Bagnold, A. Von Babo, O. H. Baldwin, R. N. Bayles, J. L. Barclay, D. Burnett, E. M. Barton, Dr. Berliner, G. W. Blodgett, Dr. E. Budde, W. R. Brixey, F. Bain, M. E. Bates, C. A. Bragg, F. A. Baux, W. G. Brown, L. G. Bronson, L. T. Boggs, J. P. Barrett, Jr., Louis Bell, F. G. Beach, G. Bliss, E. G. Bernard, C. E. Brown, Eli Blake.

C. R. Cross, C. Carpmael, W. F. Collins, E. A. Colby, A. C. Crehore, P. Carus, C. Cerruti, H. Cushman, Col. Clowry, J. A. Cabot, Wm. Carroll, Le R. C. Cooley, H. S. Carhart, A. M. Chavez, C. S. Cook, C. C. Carroll, J. Cassidy, J. H. Crantz, C. Cuttriss, C. L. Cory, F. B. Crocker, J. F. Connor, C. S. Clark, W. B. Cleveland, G. F. Curtiss, A. D. Cole, A. P. Corman, G. Cutter, T. J. Craeghead, G. Clapperton.

O. G. Dodge, T. S. Dee, M. C. Caron D'Iony, A. E. Dolbear, J. Daniel, J. S. Douglass, F. E. Drake, Louis Duncan, P. B. Delany, R. P. Dinglinger, C. A. Doremus, J. E. Davis, F. E. Degenhardt, G. S. Dunn, J. R. Dee, Fred. DeLand.

C. E. Emery, Henry T. Eddy, T. A. Edison, R. Eickemeyer, E. Egger, A. P. Eckert.

S. B. Fortenbaugh, Dr. Feussner, R. A. Fessenden, S. D. Field, H. A. Foster, S. D. Flood, A. W. Foster, H. W. Frye, T. French, I. H. Farnham, G. B. Foster, W. S. Franklin, O. Frick, G. Fisher, C. G. Fairchild, A. M. Feldman, G. C. Flegel, G. Finzi, G. Ferraris, L. A. Ferguson.

J. W. Glidden, A. Guillaume, L. Gutmann, J. H. Goehst, G. H. Guy, G. G. Grower, E. Greer, W. E. Goldsborough, Jr., F. Grassi, T. P. Gaylord, H. Gradle, W. E. Goldsborough, T. Galvao, Elisha Gray, J. V. M. Gurreiro.

J. L. Hall, E. R. Hewitt, E. Hart, W. E. Hamilton, W. J. Herdman, F. Heitman, C. S. Hammatt, G. A. Hamilton, Wm. J. Humphreys, J. A. Hornsby, Gustavus Heinrichs, L. C. Hill, Harry Hofmeister, W. G. Harte, R. O. Heinrich, E. J. Houston, O. Higman, W. F. C. Hasson, J. H. Hammer, E. H. Heinrichs, Wm. Hoskins, Dr. Von Helmholtz, G. A. Hart, A. W. Heaviside, Major Holden, H. S. Hering, C. Hering, C. C. Haskins, J. E. Ham, A. S. Hibbard, H. V. Hayes, W. C. Hubbard, F. W. Horne, E. Hospitalier.

H. G. Issertel, E. M. Izard, S. Insull.

P. C. Just, J. W. Johnson, F. E. Jackson, A. L. Johnston, A. J. Jones, I. H. Jewell, B. W. Jewell, J. L. Joyne, F. W. Jones, B. C. Jackson, M. Jewell, W. J. Johnston.

A. M. Knight, J. H. Kedzie, A. L. Kimball, W. E. Keily, E. E. Keller, A. E. Kennelly, A. de Khotinsky, N. S. Keith, E. R. Keller, W. A. Kreidler, Dr. Kurlbaum.

A. C. Longdon, E. L. Larkin, H. B. Loomis, H. Lemp, T. D. Lockwood, W. Lobach, C. W. Livermore, H. Lafavour, C. Lotter, C. D. Lawry, J. W. Langley, J. T. Lovewell, M. D. Law, Dr. S. Lindeck, L. Lombardi, P. A. Leffler, J. Love, F. H. Lamm, G. P. Low, O. Lemisch, Dr. Lemaur, Dr. Lummer.

S. F. B. Morse, W. E B. Merrell, L. O. McPherson, H. S. Manning, G. E. McFarland, J. J. Montgomery, A. F. McKissick, A. A. Michelson, L. B. Marks, R. D Mershon, S. T. Moreland, T. R. A. O. G. Montgomery, G. R Metcalfe, F. Moller, Wm. McClellan, J. A. McCrosson, A. McFarlane, G. M. Mayer, J. H. Mason, C. L. Mees, S. D. Mott, F. E. Millis, P. J. McFadden, L. A. McCarthy, C. H. McIntire, O. W. Meysenberg, Wm. Maver, Jr., G. B. Muldaur, T. C. Mendenhall, J. Moses, E. Mascart, G. A. McKinlock.

E. F. Norton, E. L. Nichols.

Max Osterberg, C. Olivette, R. B. Owens, M. O'Dea.

Wm. H. Pickering, C. W. Price, C. A. Perkins, E. L. Powers, E. Place, F. A. C. Perrine, H. C. Parker, Dr. Prinzsheim, J. Pechan, J. A. Pentz, N. W. Perry, C. A. Pettersen, R. W. Pope, W. R. Paige, G. W. Patterson, G. M. Phelps, C. A. Pike, N. Prentiss, B. Paladini, A. B. Porter, H. Pawlouski, C. Pollak, C. P. Poole, W. H. Preece, A. Palaz, J. B O'Hara, F. C. Perkins.

G. M. Redfield, R. H. Rice, Wm. L. Robb, H. J. Ryan, E. B. Rosa, F. Reckenzaun, S. Reber, E. P. Roberts, J. O. Reed, C. Ransom, H. F. Reid, A. J. Rodgers, A. L. Rotch, H. A. Rowland, H. A. Reed, R. E. Richardson, H. R. Rogers, H. L. Re Qua.

S. Semstrom, L. B. Spinney, W. M. Stine, R. St. John, B. F. Stewart, G. A. Schmidt, B. W. Snow, Wm. Shrader, F. H. Smith, C. F. Scott, A. P. Seymour, A. M. Schoen, T. A. Smith, W. L. Stevens, F. Sanford, H. Schulze, C. P. Steinmetz, L. Searing, S. H. Short, C. H. Summers, W. N. Smith, H. L. Shippy, Mr. Shea, E. Sederholm, M. J. Sullivan, W. W. Smith, E. J. Spencer, E. A. Sperry, G. Smidt, J. Stattner, G. O. Squire, Mr. Von Silineus, F. Schulze-Berge, S. Sheldon, L. L. Summers, R. A. Smith, I. O. Stockwell, J. M. Smith, H. B. Sawyer, E. Selvano, Floyd T. Short, Geo. F. Stradling, L. Soentorrstcky, A. Siemens, J. Sahulka, W. C. Stubbs, B. E. Sunny.

J. M. Taylor, H. Floy, M. E. Taylor, K. Thurman, G. L. Teeple, J. J. Thoresen, B. F. Thomas, S. P. Thompson, Elihu Thomson, Nikola Tesla, F. W. Tischendoerfer, M. de la Touanne, F. S. Terry, M. Violle, M. Thury.

A. A. Veblen, S. J. Verkonteren, Lieut. Veeder, Dr. Voit.

Hy. H. Wiegand, W. S. Wiley, J. B. Wetherell, T. C. White, F. A. Wessell, Joseph Wetzler, T. Wolcott, Chas. Wirt, E. Weston, E. R. Weeks, Wm. Wallace, A. M. Wright, W. D. Weston, J. West, A. F. Wineman, C. H. Wilson, S. S. Wheeler, E. P. Warner, E. Weiner, O. G. Webster, Hy. D. Wilkinson, R. M. Walmsley, W. C. Weston.

J. E. Zeublin, E. L. Zalinski, Wm. Zimmerman.

REPORT OF THE CHAMBER OF DELEGATES AND CLOSING MEETING OF THE CONGRESS.

The Congress was brought to a close by a general meeting of all the sections in Columbus Hall, at the Art Institute. Dr. Elisha Gray presided, and the official delegates occupied the platform. Prof. H. S. Carhart, secretary of the Chamber of Delegates, then read the report of that body containing the following recommendations :

Resolved, That the several governments represented by the delegates of this International Congress of Electricians be, and they are hereby, recommended to formally adopt as legal units of electrical measure the following :

As a Unit of Resistance the International Ohm, which is based upon the ohm equal to 10^9 units of resistance of the C. G. S. system of electromagnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross-sectional area and of the length of 106.3 centimetres.

As a Unit of Current the International Ampere, which is one-

tenth of the unit of current of the C. G. S. system of electromagnetic units, and which is represented sufficiently well for practical use by the unvarying current which when passed through a solution of nitrate of silver in water and in accordance with accompanying specifications deposits silver at the rate of 0.001118 grammes per second.

As a Unit of E. M. F. the International Volt which is the E. M. F. that, steadily applied to a conductor whose resistance is one International Ohm, will produce a current of one international ampere, and which is represented sufficiently well for practical use by $\frac{1000}{1434}$ of the E. M. F. between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15° C., and prepared in the manner described in the accompanying specification.

As the Unit of Quantity the International Coulomb which is the quantity of electricity transferred by a current of one international ampere in one second.

As the Unit of Capacity, the International Farad which is the capacity of a conductor charged to a potential of one international volt by one international coulomb of electricity.

As the Unit of Work the Joule, which is 10^7 units of work in the C. G. S. system and which is represented sufficiently well for practical use by the energy expended in one second by an international ohm.

As the Unit of Power the International Watt, which is equal to 10^7 units of power in the C. G. S. system, and which is represented sufficiently well for practical use by the work done at the rate of one Joule per second.

As the Unit of Induction the Henry which is the induction in the circuit when the E. M. F. induced in this circuit is one international volt while the inducing current varies at the rate of one ampere per second.

The committee appointed to consider the standard of light, presented the following report:

They have had much discussion upon the various forms suggested for practical standards, and in particular upon the two forms of lamps known and represented as the amyl-acetate lamp of Von Hefner Alteneck and the pentane lamp of Vernon Harcourt. The only practical lamp actually presented to the committee is the new Von Hefner lamp which, although it has been laborously tested, at the Reichsanstalt and reported accurate to within two per cent., has not received any extended trial in other hands. That thereafter it was reported that the pentane lamp in its recent improved form was preferred in England for the photometry of gas lights. There is the objection to the pentane lamp that the composition of the commercial pentane is not sufficiently well defined; and to the amyl-acetate lamp that its color is too red in hue; finally the objections to all open flame lamps is that they are too liable to be influenced by the changes in the pressure and temperature and moisture of the air. It is admitted on the other hand that no electric lamp suitable for use as a convenient practical standard has yet been realized. Under these circumstances there was a sharp division in the committee between those who advocated the Von Hefner lamp as an independent standard, and those who desired to maintain a statu quo until further researches should have been made in various countries.

It was proposed by Drs. Budde and Lummer that the Hefner-Alteneck lamp, constructed exactly according to the specifications of Mr. Von Hefner-Alteneck be introduced ,as a provisional, practical standard of light, and that the problem of determining its value in terms of an absolute unit be left to subsequent investigation. On vote this was lost by two votes for and four votes against. The following motion proposed by Messrs. Palaz and Thompson, and amended by Drs. Budde and Lummer was then carried unanimously:

Resolved, That this committee, while recognizing the great progress realized in the standard lamp of Von Hefner-Alteneck and from important researches made at the Reichsanstalt, and also recognizing that other standards have been proposed, and are now being tried, and that there are serious objections to every kind of standards in which an open flame is employed; it is therefore unable to recommend the adoption at the present time of either the Von Hefner lamp or the pentane lamp, but recommends that all nations be invited to make researches in common on well-defined practical standards, and on a convenient realization of an absolute unit.

(Signed,)

J. Violle, Edw. L. Nichols, A. Palaz, Silvanus P. Thompson.

The meeting was then addressed briefly by Prof. Helmholtz and Prof. Mascart, and after an invitation from Mr. Preece to a reception at Victoria House and the reading of a number of other invitations, the Congress was declared adjourned by Dr. Gray.

Discussion of Mr. Marks' Paper.

In the discussion which followed the reading of the paper, PROF. E. L. NICHOLS remarked that he recognized several essential advances in the lamp described by Mr. Marks; among them, that it would no longer be necessary to trim lamps daily, and the avoidance of the undue concentration of the light in the present types of lamps. In the lamp described we had apparently all the conditions and means of getting diffusion without great loss of efficiency, which is not the case with the use of the milk glass globe in general use at present. As to the use of pure carbons he was sure that manufacturers would meet the demand, and even if the price of carbons should be materially increased, their long life would more than counterbalance that disadvantage. He also thought that the distribution of light obtained by this type of lamp presented a decided advantage over the present form for general purposes of illumination.

PROF. S. P. THOMPSON described a number of experiments he had made on the arc in different gases and believed that in the incandescent arc described by Mr. Marks he had got rid of one of the complex troubles which surround arc phenomena, and congratulated the author on the results obtained towards simplicity.

MR. GEO. P. LOW referred to a lamp which had been submitted to him of Mr. W. F. C. Hasson, in San Francisco. It was of the incandescent type but employed arc carbons and a magnetizing arrangement; it was operated by extremely low E. M. F.

PROF. E. P. ROBERTS inquired whether the valve always acted to allow the gases to escape so as to avoid the bursting of the enclosing bulb. Mr. Marks, in reply, stated that though some difficulty was first experienced on this score, none was now met with, and for the last six months no mishap of any kind had occurred. Manufacturers were now able to furnish a glass which withstood the high temperature without failing in the slightest degree. He also laid stress upon the necessity for employing a pure carbon. By experiment he had obtained a carbon which would burn for hours without a trace of deposit on the enclosing bulb.

Discussion of Dr. Schulze-Berge's Paper.

In the discussion which followed the reading of the paper, Prof. E. P. Roberts inquired whether any trouble had been experienced from the breaking of the glass by concussion of the mercury, as frequently happens with the Sprengel pump. DR. SCHULZE-BERGE in reply stated that provision had been made for such an occurrence by inserting a valve which closed as soon as a break admitted the air and thus prevented concussion of the mercury. In reply to an inquiry by DR. F. A. C. PERRINE, the author stated that no trouble whatever had been experienced in his experimental pump from the fouling of the mercury. He also stated that in a large pump which he was now constructing for factory use, drawn steel tubes $\frac{1}{16}$ of an inch thick would be employed instead of glass. He had found electric welding of the joints inadequate, and made the joints by bringing the ends of the tubes together with a platinum washer while the outer portion of the joint is soldered; the platinum being interposed to prevent the mercury from reaching and attacking the solder.

Discussion of Prof. S. P. Thompson's Paper.

In the discussion following the reading of Prof. Thompson's paper, DR. CARROLL thought that greater speed could be obtained in cables by the employment of a better conductor. He exhibited an alloy of aluminum, silver and copper which he claimed had a lower resistance than copper. Its tensile strength changed greatly with the lapse of time. DR. HAMMOND V. HAYES considered that one must look at the telephonic current wave from two sides, that of attenuation and distortion, In practice it was found to-day that they were obliged to make the electromagnetic resistance sufficient to allow of high attenuation of the current.

PROF. A. JAMIESON thought that while Prof. Thompson had pointed out a possible solution we had still to rely on the cable makers for ultimate success. He also pointed out that Prof. Thompson had fallen into an error in asserting that only eight words per minute could be transmitted over the Atlantic cables; as a matter of fact, 25 words was accomplished. Again, while the present cable core cost £40 that of Prof. Thompson would cost £80. He also feared the effects of induction between the two main wires and the "induction wire" in Prof.Thompson's arrangement. The localization of faults would also be exceedingly difficult.

MR. T. D. LOCKWOOD was of the opinion that actual experiment alone could determine the truth or falsity of Prof. Thompson's position. He advised that experiments be made on a short cable.

MR. CHAS. CUTTRISS described experiments he had made to determine if the speed of cable signaling could be increased by joining a pair of parallel cables in different ways. In one experiment the cables were joined so as to make complete metallic circuit, He had made the tests on a cable containing two cores in one sheath, thus affording two independent conductors. Experiments were made with (*a*) a straight core of 517 knots; (*b*) two straight cores in parallel; (*c*) metallic circuit. An automatic transmitter was used, sending 500 reversals per minute in all experiments. The best results were obtained with the cores in parallel; next came the straight core, and last, the metallic circuit. This showed how fallacious might be the results obtained with an artificial cable.

MR. ARTHUR HEAVISIDE stated that his experience in the British postal telegraph service confirmed the results predicted by Prof. Thompson. In a set of experiments on underground telephone lines they found beneficial results followed the insertion of electromagnets at certain points.

MESSRS. W. D. WILKINSON, A. SIEMENS and PROF. C. R. CROSS made various objections on the ground of want of feasibility.

MR. TESLA'S LECTURE ON MECHANICAL AND ELECTRICAL OSCILLATORS.

On the evening of Friday, August 25, Mr. Tesla delivered a lecture before the members of the Electrical Congress, bearing the title given above, in the hall adjoining the Agricultural Building. Besides the apparatus in the room, he employed an air compressor, which was driven by an electric motor, furnished through the courtesy of the General Electric Company.

Mr. Tesla was introduced by Dr. Gray, and began by stating that the problem he had set out to solve was to construct, first, a mechanism which would produce oscillations of a perfectly constant period independent of the pressure of steam or air applied, within the widest limits, and also independent of frictional losses and load. Secondly, to produce electric currents of a perfectly constant period independently of the working conditions, and to produce these currents with mechanism which should be reliable and positive in its action without resorting to spark gaps and breaks. This he has successfully accomplished in his apparatus, and with this apparatus, now scientific men will be provided with the necessaries for carrying on investigations with alternating currents with great precision. These two inventions Mr. Tesla calls, quite appropriately, a mechanical and an electrical oscillator, respectively.

The former is substantially constructed in the following way. There is a piston in a cylinder made to automatically reciprocate by proper disposition of parts, similar to a reciprocating tool. Mr. Tesla pointed out that he had done a great deal of work in perfecting his apparatus so that it would work efficiently at such high frequency of reciprocation as he contemplated, but did not dwell on the many difficulties encountered. He exhibited, however, the pieces of a steel arbor which had been actually torn apart while vibrating against a minute air cushion.

With the piston above referred to there is associated in one of his models in an independent chamber an air spring, or dash pot, or else he obtains the spring within the chambers of the oscillator itself. To appreciate the beauty of this it is only necessary to say that in that disposition, as he showed it, no matter what the rigidity of the spring and no matter what the weight of the moving parts, in other words, no matter what the period of vibrations, the vibrations of the spring are always isochronous with the applied pressure. Owing to this, the results obtained with these vibrations are truly wonderful. Mr. Tesla provides for an air spring of tremendous rigidity, and he is enabled to vibrate big weights at an enormous rate, considering the inertia, owing to the recoil of the spring. Thus, for instance, in one of these experiments, he vibrates a weight of approximately 20 pounds at the rate of about 80 per second and with a stroke of about ⅞ inch, but by shortening the stroke the weight could be vibrated many hundred times, and has been in other experiments.

To start the vibrations, a powerful blow is struck, but the adjustment can be so made that only a minute effort is required to start, and, even without any special provision it will start by merely turning on the pressure suddenly. The vibration being, of course, isochronous, any change of pressure merely produces a shortening or lengthening of the stroke. Mr. Tesla showed a number of very clear drawings, illustrating the construction of the apparatus from which its working was plainly discernable. Special provisions are provided so as to equalize the pressure within the dash pot and the outer atmosphere. For this purpose the inside chambers of the dash pot are arranged to communicate with the outer atmosphere so that no matter how the temperature of the inclosed air might vary, it still retains the same mean density as the outer atmosphere, and by this means a spring of constant rigidity is obtained. Now, of course, the pressure of the atmosphere may vary, and this would vary the rigidity of the spring, and consequently the period of vibration, and this feature constitutes one of the great beauties of the apparatus, for, as Mr. Tesla pointed out, this mechanical system acts exactly like a string tightly stretched between two points, and with fixed nodes so that slight changes of the tension do not in the least alter the period of oscillation.

The applications of such an apparatus are, of course, numerous and obvious. The first is, of course, to produce electric currents, and in a number of models and apparatus on the lecture platform, Mr. Tesla showed how this could be carried out in practice by combining an electric generator with his oscillator. He pointed out what conditions must be observed in order that the period of vibration of the electrical system might not disturb the mechanical oscillation in such a way as to alter the periodicty, but merely to shorten the stroke. He combines a condenser with a self-induction, and gives to the electrical system the same period at which the machine itself oscillates, so that both together then fall in step and electrical and mechanical resonance is obtained, and maintained absolutely unvaried.

Next he showed a model of a motor with delicate wheelwork, which was driven by these currents at a constant speed, no matter what the air pressure applied was, so that this motor could be employed as a clock. He also showed a clock so constructed that it could be attached to one of the oscillators, and which kept absolutely correct time. Unfortunately the clock had suffered in transportation, so that its actual operation could not be observed. Another curious and interesting feature which Mr. Tesla pointed out was that, instead of controlling the motion of the reciprocating piston, by means of a spring so as to obtain isochronous vibration, he was actually able to control the mechanical motion by the natural vibration of the electro-magnetic system, and he said that the case was a very simple one, and was quite analogous to that of a pendulum. Thus, supposing we had a pendulum of great weight, preferably, which would be maintained in vibration by force periodically applied; now that force, no matter how it might vary, although it would oscillate the pendulum, would have no control over its period. Mr. Telsa also described a very interesting phenomenon which he illustrated by an experiment. By means of this new apppratus, he is able to produce an alternating current in which the E. M. F. of the impulses in one direction preponderates over that of those in the other, so that there is produced the effect of a direct current. In fact he expressed the hope that these currents would be capable of application in many instances, serving as direct currents. The principle involved in this preponderating E. M. F. he explains in this way: Suppose a conductor is moved into the the magnetic field and then suddenly withdrawn. If the current is not retarded, then the work performed will be a mere fractional one; but if the current is retarded, then the magnetic field acts as a spring. Imagine that the motion of the conductor is arrested by the current generated, and that at the instant when it stops to move into the field, there is still the maximum current flowing in the conductor; then this current will, according to Lenz's law, drive the conductor out of the field again, and if the conductor had no resistance, then it would leave the field with the velocity it entered it. Now it is clear that if, instead of simply depending on the current to drive the conductor out of the field, the mechanically applied force is so timed that it helps the conductor to get out of the field, then it might leave the field with the higher velocity than it entered it, and thus one impulse is made to preponderate in E. M. F. over the other. With the current of this nature, Mr. Tesla energized magnets strongly, and performed many interesting experiments, bearing out the fact that one of the current impulses preponderates. Among them was one in which he attached to his oscillator a ring magnet with a small air gap between the poles. This magnet was oscillated up and down 80 times a second. A copper disc, when inserted within the air-gap of the ring magnet, was brought into rapid rotation. Mr. Tesla remarked that this experiment also seemed to demonstrate that the lines of flow of current through a metallic mass are disturbed by the presence of a magnet in a manner quite independently of the so-called Hall effect. He showed also a very interesting method of making a connection with the oscillating magnet. This was accomplished by attaching to the magnet small insulated steel rods, and connecting to these rods the ends of the energizing coil. As the magnet was vibrated, stationary nodes were produced in the steel rods, and at these points the terminals of a direct current source were attached. Mr. Tesla also pointed out that one of the uses of currents such as those produced in his apparatus, would be to select any given one of a numb r of devices connected to the same circuit by picking out the vibration by resonance; and he referred in a complimentary way to the work of Dr. Gray in harmonic telegraphy. There is indeed little doubt that with Mr. Tesla's devices, harmonic and synchronous telegraphy will receive a fresh impetus, and vast possibilities are again opened up.

Mr. Tesla was very much elated over his latest achievements, and said that he hoped that in the hands of practical, as well as scientific men, the devices described by him would yield important results. He laid special stress on the facility now afforded for investigating the effect of mechanical vibration in all directions, and also showed that he had observed a number of facts in connection with iron cores. Mr. Tesla's enthusiastic belief in the usefulness and success of the practical applications of his latest devices appears to be fully justified. Although but briefly outlined by him, what he showed was sufficient to indicate that this latest work of his would transcend in importance, probably, all of his previous brilliant work, not excepting even his alternating current motor. We had heretofore been accustomed to look upon Mr. Tesla as an electrician of the highest type, but the work which he has accomplished in this new field of mechanical oscillators entitles him to rank equally high as an engineer.

IMPORTANT RUMORS.

We are informed that on the recommendation of Prof. George Forbes, the Cataract Construction Co. have adopted Mr. Tesla's multiphase system as the sole method of distribution at Niagara Falls.

Rumors of serious differences between the General Electric and Fort Wayne Electric Companies seem to be well founded. We are credibly informed that their relations are severely strained and that an open rupture is feared. It is believed that the General Electric Co. owns less than a controlling interest in the Fort Wayne Co., and that Mr. R. T. McDonald and his directors are in a position to declare their independence if and when they want to.

ON THE TRANSMISSION OF ELECTRIC SIGNALS THROUGH SPACE.[1]

BY W. H. PREECE, F. R. S.

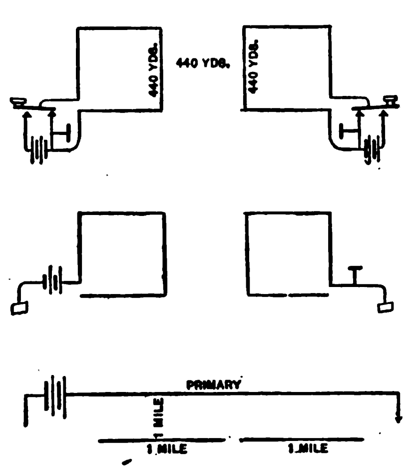
THE author began by referring to the work of Henry in 1842 who transmitted signals by magnetized needles and Leyden jars 30 feet away. Disturbances on telephone lines and induction between them and telegraph wires was touched upon as well as Mr. Edison's method of utilizing the electrostatic influence between a pole line circuit beside a railway track and a telephone circuit on a moving train in 1885. Experiments to discover whether the effects observed in England were independent of the earth and also to determine how far such inductive influences extended were made by the author in the same year. It was found that on ordinary working telegraph lines the disturbance reached a distance of 3,000 feet, while effects were detected on parallel lines of telegraph from 10 to 40 miles apart in some sections of the country. In the latter instances, however, the presence of a network of wires between those experimented upon may have introduced electrostatic effects. Two lines were therefore selected 14 miles long and about 4½ miles apart where no intermediate wires existed.

If we have two parallel conductors separated from each other by a finite space, and each forming part of a separate and distinct circuit, either wholly metallic or partly completed by the earth, and called respectively the *primary* and the *secondary* circuit, we may obtain currents in the secondary circuit either by conduction or by induction, and we may classify them into those due to: 1. Earth currents. 2. Electrostatic induction. 3. Electromagnetic induction. It is very important to eliminate (1), which is a case of conduction, from (2) and (3), which are cases of induction.

Since 1885 the author has made a vast number of experiments in order to thresh out the laws and conditions that determine the distance at which magnetic disturbances can be usefully evident. The instrument used to receive these signals has been generally the telephone, but many absolute measurements have been made with a very sensitive reflecting galvanometer.

I.—To prove that the effects were due to electromagnetic induction. Conductors of copper wire insulated with gutta-percha were formed into quarter mile squares and laid on a level plain a quarter of a mile apart as in Fig. 1. Arrangements were made for sending vibratory or alternating currents which could be broken into Morse signals by means of a telegraph key. Telephones were used as receivers, which transformed these signals into buzzing dots and dashes. On closing the circuit in one square and sending signals, conversation could be readily held between the two operators by means of the Morse code. Obviously, earth conduction could play no part in this transmission of signals, for the squares were insulated throughout from the earth. Next, in order to ascertain to what extent, if any, electrostatic effects were observable, one pole of the battery used was put to earth, and the further end of each square was disconnected.

By this arrangement, the mean electric force of one square was doubled, as compared with the former experiment, where the circuit was completed, but no effect was observed in the second square, either in the receiving telephone or with the reflecting galvanometer. The squares were even superposed at a distance of only 15 feet apart, the upper one being suspended on poles, and the lower one lying on the ground, but without any result. Hence, the effects observed in this experiment were clearly due to electromagnetic induction.



FIGS. 1, 2 AND 3.

II.—To prove that the effects increased directly with the strength of the primary current used and diminished with the resistance of the secondary current. (*a*) Two quarter mile squares of insulated wire, Fig. 2, were opposed to one another, the distances between the front faces varying from 8 yards to 192. Currents of one and two amperes respectively were sent into one square, and the induced effect in the second square with two amperes was invariably twice that with one ampere. The measurements were made with a reflecting galvanometer. (*b*) Open wires were placed parallel to one another, a mile apart horizontally, Fig. 3. The primary circuit was two miles long. The other, the secondary circuit, was divided into two equal one mile lengths. With a primary current of .22 ampere the vibrations were just audible in a telephone fixed to either of the single mile lengths of the secondary,

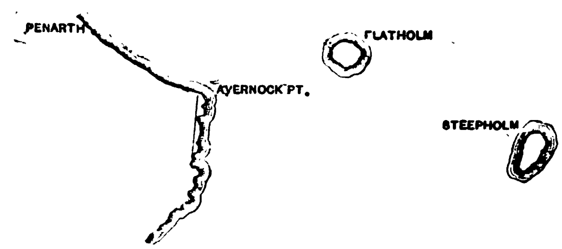


FIG. 4.

the total resistance in the latter circuit being 85 ohms. With a similar current (.22 ampere) in the primary and the secondaries joined into a two mile length, the same limit of audibility was reached when the resistance in the secondary was doubled, that is, it was raised to 170 ohms. Next, the current in the primary was doubled or increased to .44 ampere; and with a one mile secondary the total resistance had to be doubled in order to reach the same limit. Finally, when the current in the primary was raised to .88 ampere—four times the original figure—then the same limit was reached when the resistance was quadrupled.

Experiments were also made to find how the effects varied with the length of the inductive system and with the distance separating them. The law for variation of length and distance is very complicated and depends wholly on the form of the circuit and its various reactions.

The Bristol channel proved a very convenient locality to test the practicability of communicating across a distance of three and five miles without any intermediate conductors. On the shore, two copper wires, weighing 400 lbs. per mile, combined in one circuit, were suspended on poles for a distance of 1,267 yards, the circuit being completed by the earth. On the sands, at low water mark, 600 yards from this primary circuit and parallel to it, two ordinary gutta-percha-covered copper wires and one bare copper wire were laid down, their ends being buried in the ground by means of bars driven in the sand. One of the gutta-percha wires was lashed to an iron wire to represent a cable. These wires were periodically covered by the tide, which rises here at spring to 33 feet. On the Flat Holm, 3.1 miles away, another gutta-percha covered copper wire was laid for a length of 600 yards. Fig. 4 shows a map of the field of operation.

There was also a small steam launch, having on board several lengths of gutta-percha covered wire. One end of such a wire, half a mile long, was attached to a small buoy, which acted as a kind of float to the end, keeping the wire suspended near the surface of the water as it was paid out while the launch slowly steamed ahead against the tide. Such a wire was paid out and picked up in several positions between the primary circuit and the islands.

The apparatus used on shore was a 2 h. p. portable Marshall's steam engine, working a Pike & Harris's alternator, sending 192 complete alternations per second, with a voltage of 150 and of any desirable strength up to a maximum of 15 amperes. These alternating currents were broken up into Morse signals by a suitable key. The signals received on the secondary circuits were read on a pair of telephones, the same instruments being used for all the experiments. The object of the experiments was not only to test the practicability of signaling between the shore and the lighthouse, but to differentiate the effects due to earth conduction from those due to electromagnetic induction, and to determine the effects in water.

It was possible to trace, without any difficulty, the region where the lines of current flow ceased to be perceptible as earth currents and where they commenced to be solely due to electromagnetic waves. This was found by allowing the paid-out cables suspended near the surface of the water to sink. Near the shore no difference was perceptible whether the cable was near the surface or lying on the bottom, but a point was reached, just over a mile away, where all sounds ceased as the cable sank but were recovered again when the cable came to the surface.

The total absence of sound in the submerged cable leads to the conclusion either that the electro-magnetic waves of energy are dissipated in the sea water, which is a conductor, or else that they

1. Abstract of a Paper read at the International Electrical Congress, Chicago, Aug. 21-25, 1893.

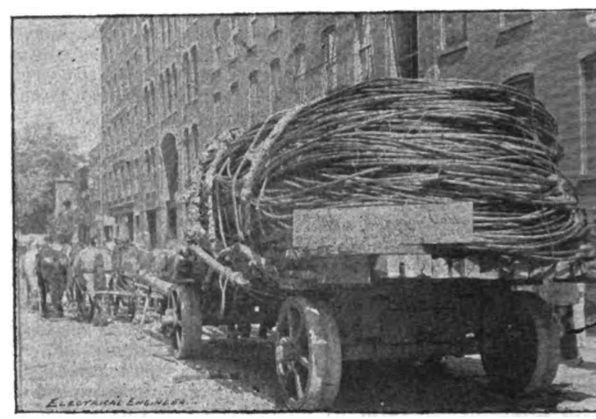
are reflected away from the surface of the water like rays of light.

There was no difficulty in communicating between the shore and Flat Holm and messages were read. The distance between the two places was 3.1 miles. The attempt to speak between Lavernock and Steep Holm was not so successful. The distance was 5.35 miles, but though signals were perceptible, communication was impossible. The fact indicated by the formula for parallel wires that the limiting distance increases directly with the square of the length of the circuits, has a very important bearing on the practical results of these experiments, for it shows that if we can make the length of the two lines long enough, it would be easy to communicate across a river or a channel. There is little doubt that two wires, 10 miles long, could signal through a distance of 10 miles with ease. Although communication across space has thus been proved to be practical in certain conditions, those conditions do not exist in the cases of isolated lighthouses and lightships, cases which it was specially desired to provide for. The length of the secondary must be considerable, and for good effects, at least equal to the distance separating the two conductors. Moreover, the apparatus to be used on each circuit is cumbrous and costly, and it may be more economical to lay an ordinary submarine cable. Still, communication is possible even between England and France, across the Channel, and it may happen that between islands where the channels are rough and rugged, the bottom rocky, and the tides fierce, the system may be financially practical. It is, however, in time of war that it may become useful. It is possible to communicate with a beleagured city either from the sea or on the land, or between armies separated by rivers, or even by enemies.

A use to which these electromagnetic disturbances can be applied is to indicate to ships their contiguity to lighthouses and land falls. Experiments are being made in this direction by Mr. Stevenson of the Northern Lights Commission on the coast of Scotland, but no results have yet been published. He proposes to submerge a cable on a given fathom line through which special automatic distinguishing signals are being sent, so that a ship approaching or crossing this line can pick up these signals on board and learn her true position by day or night independent of fog.

LAYING OF THE SUBMARINE TELEGRAPH CABLE BETWEEN THE ISLE OF SHOALS, N. H., AND THE UNITED STATES.

Up to the present season, the Messrs. Laighton, the proprietors of the Isle of Shoals, have made it their boast, that in their hospitable island the weary business man could find utter seclusion from business worries, and be absolutely beyond the reach of the telegraph or the telephone. In these advanced days, however, their claim has been thought to be not so powerfully attractive as it once was, and for some years many of the more progressive visitors to the Shoals, and citizens of Portsmouth, have been urging the necessity of telegraphic communication with the mainland, as it is not of infrequent occurrence that the hotels are entirely cut off from all communication with the mainland during heavy gales. As a result, some few months ago, the Gardner Cable Company was incorporated under the laws of New Hampshire, consisting of the following gentlemen: Joseph H. Gardner, Oscar Laighton, Willard J. Sampson, Edward D. Coffin, John J. Laskey, F. W. Hartford, and E. L. Guptill. Bids were requested from various manufacturers, and the matter drifted slowly along until Mr. F. M. Ferrin, representing C. S. Knowles, of Boston, took the matter in hand, and after considerable work eventually persuaded the Gardner Cable Company to have the cable laid this summer, and secured the contract. Mr. C. S. Knowles, being agent for the Safety Insulated Wire and Cable Company of New York, turned the cable over to them for manufacture, and after considerable delay owing to the magnitude of the work, the cable was ready for shipment by Monday, August 14. As the cable was all made in one length, about seven miles in all, and weighed about thirty-five tons, the matter of shipping was not an easy one. First, it was coiled on to a heavy truck, the same one that transported the cable of the Broadway Cable Company, the work of coiling taking 15 men about twenty hours. Eighteen horses then dragged the truck to the wharf, where the cable was wound round a vertical drum, which had been built in the capacious hold of the old reliable barge or scow "Lizzie." This operation consumed about another day, but finally on Wednesday night at 11.30 the steam tug "R. C. Veit" of New York started with its tow, arriving safely at the Isle of Shoals on Saturday morning about eight o'clock, where a party of ladies and gentlemen from Appledore boarded the tug to witness the operation of laying the cable. The tug was then headed for Wallis Sands on the mainland, a sandy shore not far from Rye Beach where one of the Atlantic cables lands. Arrived there, the barge was allowed to drift in with the waves until about 1,000 feet from shore, where she dropped anchor and preparations were made for landing the shore end. As the surf was rolling quite high this was a matter of some difficulty, but Mr. Ferrin, accompanied by Mr. W. G. Chase, who had his camera with him, and a number of men, finally succeeded in landing on the beach, after a little wetting, with a line attached to the end of the cable. Willing hands of every man woman and child in the vicinity, then grasped the rope, and with a long pull and a strong pull, and a pull altogether, they soon succeeded in securing the end of the cable to some strong stakes driven in the sand two or three hundred feet back of the water line, where the end was left in charge of some Western Union men, who soon had it connected to the overhead lines. Coming aboard again, a start was soon made for Appledore, the tug towing the barge about two hundred feet astern, and the cable was paid over the stern of the barge at the rate of about two miles an hour. All went well, though there were a number of considerable delays owing to some the strands of the armor occasionally becoming fouled in the hole through which the cable passed, until when about 1,000 feet from Appledore it was discovered that the cable had given out, undoubtedly owing to the tug having gone out of her course on more than one occasion, and instead of being able to make a successful landing, the end was securely fastened to the moorings of an adjacent schooner and wires were attached to the end brought on board. This was accomplished about 6.30 p. m., and at 9.30 communication was established with the mainland, the first message being transmitted to Mr. Laighton about 9.45 and being as follows: "At last you are connected with the United States. Praise God, from whom all blessings flow." Later Mr. Ferrin succeeded in running temporary wires between the end of the cable and the hotel office, so that now the cable is in complete working condition and in actual service.



Truck Loaded with Seven Miles of Safety Cable and Drawn by Eighteen Horses.

The cable, which is the longest ever made in the United States, measures about 36,000 feet, and consists of two conductors, each conductor being of three strands. The conductors are heavily insulated with rubber and taped and twisted together and then heavily served with a hemp covering well soaked in a tarry compound. The whole is then well protected by a heavy armor consisting of fifteen strands of No. 8 galvanized iron wire, making a very handsome and substantial piece of work.

An illumination and a "German" celebrated the event in the evening, and Mr. Ferrin was the recipient of many congratulations upon the completion of his work.

THE DUPLEX TELEPHONE COMPANY.

The New York *Tribune* of August 19 in its Mount Vernon, N. Y., news says: The Duplex Telephone Company has been formed here, and permission has been given by the Common Council to put up wires. The new company has a system, it is asserted, superior to the Bell patent, and it is intended to establish a telephone exchange and connect with it a messenger service. The company is a local one, its stockholders and officers being business men here. The new company claims that it will give better telephone service at about one-half the present cost. Its officers are: Franklin T. Davis, president; S. H. Gray, vice-president; J. W. Downs, treasurer; and F. T. Davis, S. H. Gray, J. W. Downs, Horace Granfield, Dr. H. Eugene Smith and J. T. Maguire, directors.

THE ATWOOD ELECTRIC HEADLIGHT COMPANY.

The Atwood Electric Headlight Co., of St. Louis, has been incorporated with a capital stock of $125,000, by C. Atwood, E. B. Roth, M. Keber, J. W. Phillips and D. McLaren.

John E. Nelson, town councillor of Glasgow, and John Morrison, a Glasgow contractor, are in this country inspecting the street railway systems of the United States and Canada.

UNDERGROUND WIRES FOR ELECTRIC LIGHTING AND POWER DISTRIBUTION.[1]

BY PROF. D. C. JACKSON.

THE author spoke of the obvious advantages of placing wires underground, and mentioned the two methods in use in this country, viz., (1), Solid or built systems, and (2) Drawing-in or conduit systems. A complete subway system consists of three parts, the conduit, the drawing-in manholes, and arrangements to get at the cables for service connections. There are at present in successful use in America four typical forms of conduit; cast or wrought iron pipe, cement lined sheet iron pipe, tile, terra cotta or clay pipes and wooden tubes. Of these, glazed terra cotta is most used, in sections three feet long with rectangular ducts, each containing at least three cables. It is water tight and nearly gas tight and the glaze has quite a high electrical resistance. The conduit should be laid with its top about 2 feet below the pavement when in concrete; without concrete, at about 3 feet. The tile conduit should be laid in a bed of from 2 inches to 6 inches of concrete, and covered with concrete to that depth, so that when the whole has hardened it is like a continuous set of stone ducts. The top may be further protected by creosoted board when the conditions make it necessary. Joints between the sections are made, either by wrapping the joints with several layers of burlap strips soaked in hot asphalt, or by means of a tile sleeve over the joint which is cemented on. The latter joint is usually used when the conduit is laid in concrete, and in laying the conduit it is then usually sufficient to simply bring the sections together in a line in a trench, and fill in with concrete.

House services are sometimes taken off from this type of conduit by means of hand poles, in front of each house, using a subsidiary duct of iron pipe running into the basement; and sometimes the service wires are taken from the manholes and carried into each block by the subsidiary duct, whence they are distributed overhead from roofs or otherwise. The all underground method is the best, but it is more expensive so it is less frequently used.

The experience of those who have used tile conduits seems to be very favorable, especially in the smaller cities. In Washington it is highly praised, both by the telephone and electric light companies, and telephone companies in Baltimore, Chicago, Pittsburgh, Milwaukee, and other cities consider it successful.

The simplest of all conduits and one which is used quite generally, is a common wrought iron gas or steam pipe, either laid bare in the ground or in a bed of concrete. Ducts are usually of 2 inch to 3 inch pipes, and since a 3 inch pipe will carry four ordinary electric light cables the system is economical of space in the streets. Joints in the pipe are made with a sleeve screwed on with a vanishing thread which is cut so that the ends of the pipe come close together inside the sleeve. The sections of pipe are generally 20 feet long. The great advantage iron pipe has over all other forms of conduit is its flexibility. Experience in New York and Chicago proves that cables can be pulled easily around several bends with radii of 3 feet or less.

The best method of laying iron pipe ducts is in concrete, with the pipes about 1¼ inches apart. It is sometimes best, as an extra precaution against mechanical injury, to box it in at least on the top and sides with creosoted plank. Iron has been found to have no bad effects on the lead covers of the cables, either while drawing in or by chemical action after they are in, although it is possible for rust to so fill up the ducts that the cables cannot be easily withdrawn. The only bad feature of this form of conduit is its magnetic qualities. If an alternating current is carried through an iron duct, and the return wire is in another duct, the self induction is greatly increased and the loss of pressure is considerable. In one case where the effect of iron conduits upon the loss of pressure in electric light cables was tested, the loss due to impedance was found to be a considerable factor. Mr. Preece finds a fall of pressure of two volts with a current of 7.2 amperes and resistance of .0068 ohm, when the conductors are thus arranged. He concludes that the losses are due to hysteresis and eddy currents in the pipe, and is consequently opposed to the use of iron for this purpose. A satisfactory commercial remedy for the effects is to put both sides of the circuit into the same duct, and as close together as possible. A great many cables used in some of the cities are made with the outgoing and incoming wires duplexed together for this purpose.

Wood conduits are used considerably in Philadelphia. The thickness of the walls is about 1¼ inches, the top usually covered with a two inch plank for extra mechanical protection. The commonest form of wood conduit is made up of 4 x 4 inch pieces of wood with a 3 inch hole bored through from end to end. These are jointed either by a male and female union, or by simply butting the ends together. For a preservative of the wood, oil of coal tar, carbolineum and other compounds have been used. One of the greatest advantages claimed for the wood conduit is its accessibility. The greatest disadvantage is the chemical effect of the preserving compound on the lead covering of the cables. The lead is entirely destroyed by chemical action in a short time when in the presence of wood preservative, unless it is protected by hemp braiding, alloying with tin, etc. Since the life of braiding is limited, and tin does not alloy evenly with lead, the rate of depreciation of cables in these conduits is usually great. Wood conduits properly treated with preservatives should last thirty years, and untreated fifteen years.

The only type of conduit which is being used on a large scale is the cement lined iron pipe. The tubes for this conduit consist of a tough sheet-iron shell, rivetted, and lined with ⅝ inch of pure cement, no sand being used, and the inside being carefully smoothed. The pipes are made in 8 foot lengths and of various diameter. The weight per foot of 3 inch duct (which is generally used) is about 5 pounds, as compared with 7½ pounds for wrought iron pipe. It is claimed that the pipe is water and gas tight, and proof against acids and alkalies. Distribution is always effected from manholes or handholes, the subsidiary ducts being generally 1 inch wrought iron pipes.

Its main advantages are durability, smoothness and cheapness as compared with iron pipe.

For electric light cables, especially where several companies occupy the same conduit, larger manholes are necessary. An ordinary standard size is 6 feet square and 7 or 8 feet deep. When the conduit consists of few ducts near the surface, a much smaller hole, three or four feet deep, may be used, with a large cover so that workmen can practically stand in the street, while working at the cables. The walls should be of brick, laid in cement and there should be a 6 inch concrete foundation. The cover should be of cast iron on a ring casting set on the brick work and well fastened by anchor bolts. Where double covers are used the inner one should be screwed down in a rubber gasket. The cables should be hung against the sides that they may be readily reached. Handholes are either on the surface or buried. The latter are usually best as so many covers along a street are objectionable. Some method of draining should be provided, but in large cities gas is even more to be guarded against than water, and the pressure in the conduits should be kept greater than that in the street by means of blowers as used in New York, where about 1 h. p. per mile of subway is required at the blower, delivering about 500 feet of air per hour to each manhole. In some places where the blower is not used, the manhole is connected by a pipe to a hollow electric light pole which acts as a chimney.

1. Abstract of a Paper read before the International Electrical Congress, Aug. 21-25, 1893.

REPORTS OF COMPANIES.

SUSPENSION OF WALLACE & SONS AND THE ANSONIA ELECTRIC COMPANY.

WALLACE & SONS, manufacturers of brass and copper goods at Ansonia, Conn., with offices at 29 Chambers street, N. Y., have been forced to suspend on account of the hard times. Thomas Wallace of Ansonia, the treasurer of the concern, and Robert M. Thompson, president of the Oxford Copper Company, have been appointed receivers, both in this State and in Connecticut, on the application of John B. Wallace, the secretary, and Uriah T. Hungerford, the manager of the New York office. The business was established in 1848 at Ansonia and was incorporated in 1853, with a capital stock of $100,000. It is a close corporation, the stock being held by the Wallace family and Mr. Hungerford. The company has large rolling mills, wire mills, and factories at Ansonia. The actual cost of the plant and machinery, it is said, exceeded $1,000,000, and is unincumbered. The company employs from 1,000 to 1,400 hands at the mills.

The company could not meet a note for $25,000 which fell due last Tuesday, August 22. Other notes to the amount of $50,000 fall due before September 1, and the balance of the notes out mature in the next two or three months. The company was unable to make collections from its customers on account of the stringency of the money market, and creditors threatened to attach.

The liabilities are placed at $875,000, of which $450,000 is on open accounts, nearly all of which are past due, and $425,000 on notes. The nominal assets are put down at $2,000,000, of which the plant and machinery is valued at $1,000,000, the book accounts (which are supposed to be good) at $600,000, and the merchandise at $400,000, of which about $50,000 is in this city.

The paper of the concern is largely held by the Bank of America, it is said, the Importers' and Traders' Bank of this city, and the Ansonia National Bank of Ansonia, Conn., and was generally sold by Platt & Woodward, note brokers, of New York City.

As a result of this suspension, the Ansonia Electric Company went into the hands of receivers Saturday. John B. Wallace, the president, was appointed receiver for Connecticut, and John B. Waller, his brother-in-law, of Chicago, receiver for Illinois. Both have qualified. The company employed 125 hands at Ansonia, Conn., and 75 in Chicago. Liabilities $300,000; assets much greater. The stock is almost entirely held by the Wallace family. Wallace & Sons expect to resume under the receivership September 4.

These suspensions have been noted with extreme regret throughout the electrical community, and the hope is everywhere entertained that both industries will soon be on their feet again.

ENGINES IN THE HUDSON ELECTRIC LIGHT AND POWER CO.'S PLANT, HOBOKEN, N. J.

We illustrate in detail herewith the vertical cross compound condensing engines, shown in the half-tone, and now in use at the Hudson Electric Light and Power Company's station, Hoboken, N. J. There are two engines placed in the same engine house, which are nominally 500 h. p. each, but which develop 800 h. p., using steam at 125 lbs. pressure per square inch in the boilers, and controlling with the governor by liberating the steam gear of the high pressure cylinder. The high pressure cylinders are 20 inches in diameter, the low pressure cylinders 36 inches in diameter, and the stroke common to each 36 inches long.

The engines run 103 revolutions per minute. A careful examination of the illustrations gives the full data of these machines:—The shaft journals are 12 inches in diameter and 24 inches long, being 2 inches larger than is usual to put on a cylinder of this size. The centre of the shaft where the wheel is keyed on is 14 inches in diameter. The fly-wheels are 17½ feet in diameter and 54 inches face, weighing, when finished, 47,000 lbs. each.

The peripheral velocity of these wheels is 5,660 feet per minute, driving on to a counter-shaft, from which the different electric generators are driven. These engines are controlled by a counter-weighted governor of the "Porter" type, and give exceedingly steady movement. They are used for electric railway and arc and incandescent lighting.

Though the revolutions are high for a liberating gear engine of this size, they are found to operate very satisfactorily, and, above all, economical. To obtain this the largest area of valves is used.

The throttle valve is 7 inches in diameter, which is an unusually large size for a 20 inch cylinder. The ports and openings through the valves are likewise very ample, so that the card shows very little resistance to the steam passing through the cylinders. Beside this, between the two cylinders and situated directly below the platform—indeed forming a part of it, is a reheater, rectangular in form, through which extend, from end to end, a series of solid-drawn brass tubes, which are heated by live steam from the boilers and drain back to them. This steam serves to superheat the steam after doing its work in the high pressure cylinder, and and thereby lessens the usual large condensation of the low pressure cylinder.

It is the belief of the manufacturers of these engines, the Philadelphia Engineering Works, Limited, that where this is carried out in practice to a liberal, or preferably to an extreme, extent, steam jacketing of engines of reasonably high rotative velocity is no benefit whatever, especially with engines where the cooling surface of the cylinders themselves, which are alternately acted upon by incoming and outgoing steam, is reduced to a minimum, as they are in the usual type of Corliss valve gear. When piston valves or other forms of balance valves are used, and when the steam is admitted and discharged through the same openings, and over the same surface, the condensing area of the cylinder promoting initial condensation in the cylinder (which is entirely apart from the radiation to the atmosphere, and which will go on independent of that radiation, and almost indifferent to it), should be added to the internal surface areas of the cylinder while the piston displacement remains constant. The many efforts that have been made by high rotative velocity to decrease the cylinder condensation, have been practically abortive through this mistaken idea, it is said, of using the same openings of large superficial areas, for the eduction and induction of steam. Happily the genius of Geo. H. Corliss removed these essential errors and reduced the surface as compared with the piston displacement to a minimum, while at the same time constructing valves which are subjected to the least wear, and which of themselves may wear while keeping tight. Apart from this valuable introduction of the liberating gear controlled by the governor, this one feature of his engines is beyond all others of the greatest advantage. These engines are the forerunners of what this firm will offer in the very near future; that is, high speed, liberating gear, genuine Corliss engines. The smaller class of these engines will have a rotative velocity of 150 revolutions and the largest ones 125 revolutions per minute. The small engines will drive, when belted direct, the smaller class of generators (or other machinery of factories and the like), and the largest class of engines are intended to have the generators placed upon the main shaft of the engine. These engines will be constructed of the horizontal-vertical type, having one end of the shaft entirely free. They are said to be the most compact engines yet placed upon the market, occupying less room than the vertical or horizontal engines.

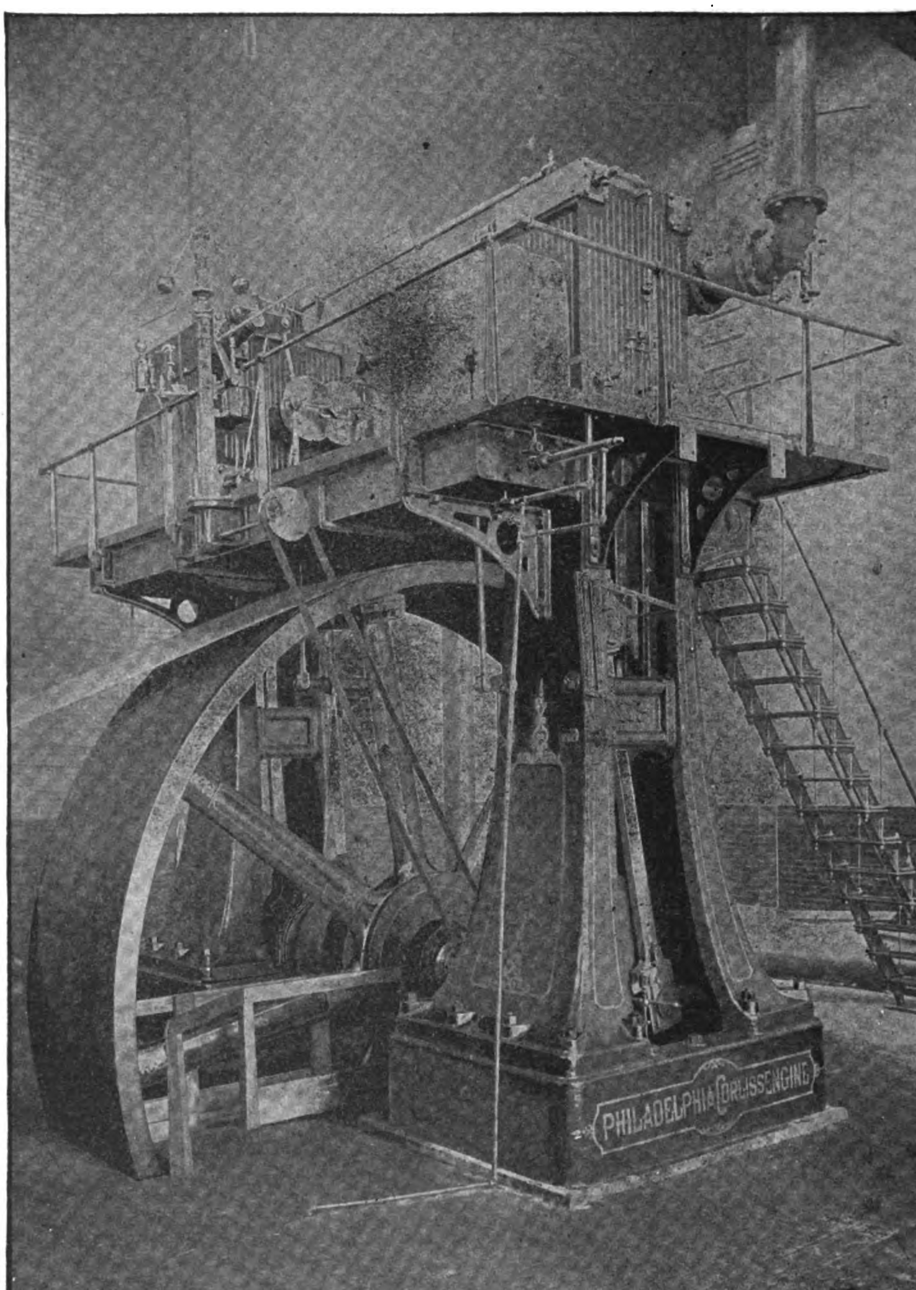
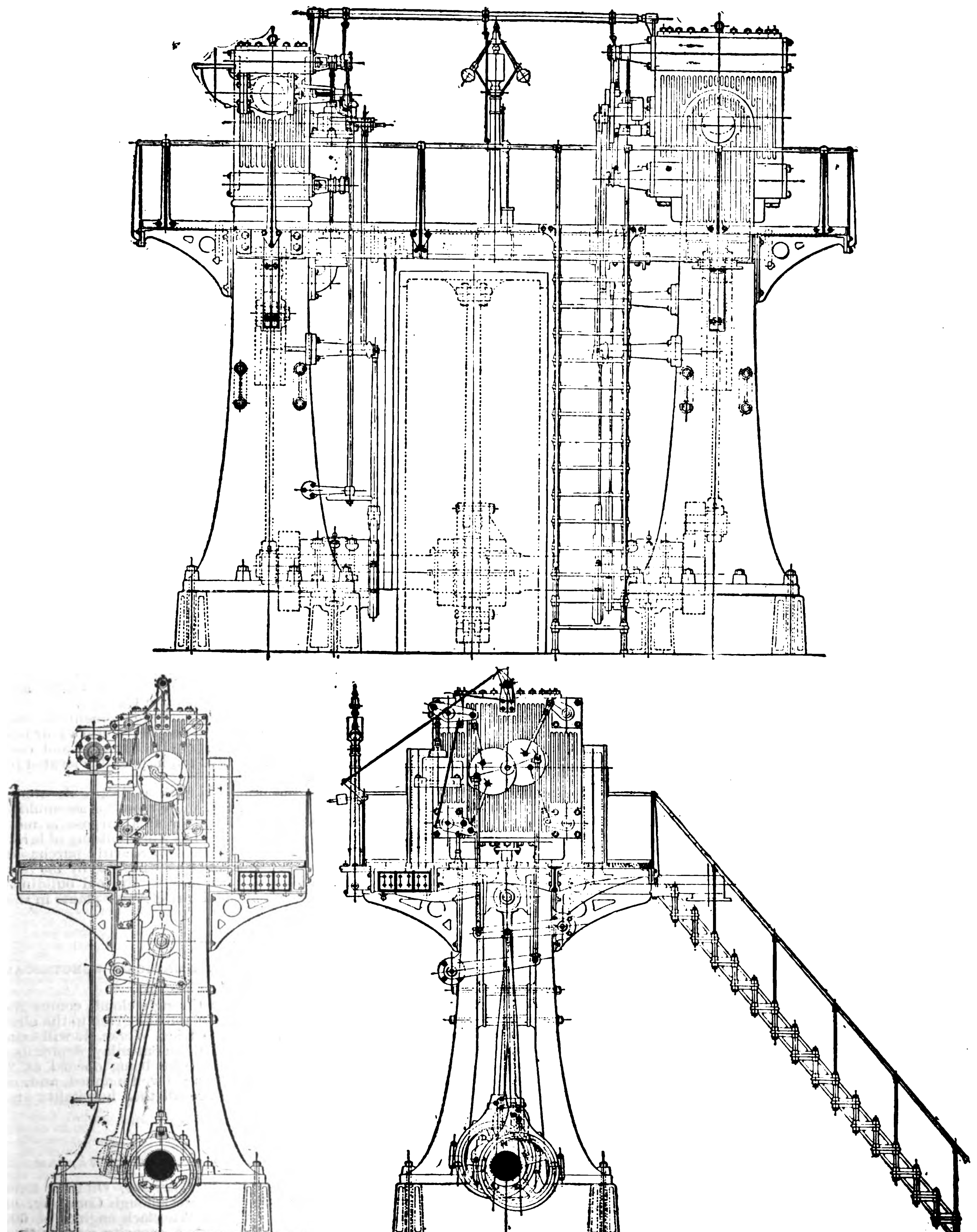


Fig. 1.—Vertical Engine of the Philadelphia Engineering Works, Ltd., Hudson Electric Light and Power Co.'s Plant, Hoboken, N. J.

The advantage claimed by the electrical engineers for a direct driven generator is essentially that due to large machines as against a multitude of small ones. They are claimed to be more



FIGS. 2 AND 3.

efficient, having less parts than a number of small machines, to require less oil, less attention, and to occupy less room and for the same power delivered cost less money for installment, when the cost of the ground and the buildings are considered.

In a recent letter to the Philadelphia Engineering Works, Limited, Mr. A. K. Banta, superintendent of the Hudson Electric Light and Power Co., writes that these engines in his station have been very economical of fuel, and that the Company is adding another of not less than 1,000 h. p. This may be taken as a fair indication of their value.

SOCIETY AND CLUB NOTES.

MEETING OF THE ELECTRICAL COMMITTEE OF THE UNDERWRITERS' INTERNATIONAL ELECTRIC ASSOCIATION.

A MEETING of the Electrical Committee of the Underwriters' International Electric Association was held in Chicago on August 17, 18 and 19, at the rooms of the Chicago Fire Underwriters' Association. The full committee, consisting of the following gentlemen, were present:

F. E. Cabot, supt. of the survey and electrical department of of the Boston Board of Fire Underwriters; Geo. P. Low, electrical inspector of the Pacific Insurance Union; Wm. McDevitt, inspector of Philadelphia Fire Patrol and Philadelphia Fire Underwriters' Association; E. A. Fitzgerald, electrical inspector of the Underwriters' Association of N. Y. State; Wm. H. Merrill, Jr., electrician of the Chicago Fire Underwriters' Association; Edward Leloup, electrical inspector of the Southeastern Tariff Association; A. E. Van Geisen, electrical inspector of the New York Board of Fire Underwriters; C. E. Bliven, western manager of the American Fire Insurance Co. of Philadelphia; C. M. Goddard, secretary and electrician of the New England Insurance Exchange.

The following also were in attendance and took part in the discussions of the committee:

G. F. Bottom, electrical inspector of the Board of Fire Underwriters of Kansas City, Mo.; Geo. W. Cleveland, electrician of the Cleveland Board of Underwriters; A. W. Bennett, electrical inspector of the Milwaukee Board of Fire Underwriters; C. C. Haskins, city electric light inspector of Chicago; J. J. S. Wilson, chief of city electrical inspection department of Chicago.

There were also in attendance at the meeting, at various times, many prominent underwriters connected with the Western Union and Chicago Fire Underwriters' Associations.

The committee spent the first day and a half in the careful revision of the rules which were formulated by the association early in the year, and which have now been adopted by nearly all of the underwriters organizations of the United States. These rules were amended in some few points, where experience and consultation indicated such amendments to be necessary.

Particular attention was given to the matter of the use of current from single trolley systems for lighting and power, and the prohibition contained in the rules on this point was amended so as to make it more emphatic, it being the unanimous opinion of all present that the hazard created by using a grounded system in insured buildings was such that prompt and energetic action was needed to prevent such installations from obtaining a foothold.

After the discussion of the rules, the matter of apparatus and wires was brought up, considerable time being devoted to the consideration of insulating joints.

On Aug. 19, the subject of Automatic Fire Alarms was very thoroughly discussed and steps were taken to formulate a plan by which the approval and installation of thermostat systems could be made more uniform, and the protection afforded by such systems more efficient, the general opinion seeming to be that, except in the Eastern states, the assured were receiving considerable rebates on account of thermostat systems, while the protection afforded and the benefit to the companies was exceedingly small, if of any value whatever.

In order to divide the work of the committee among its various members it was decided to arrange the subject of electricity as affecting the underwriting interests under various heads and assign them to the different members of the committee. This was done as follows:

Enforcement of Rules and Financial Support of the Association, Mr. Bliven; Central Stations and Isolated Plants, Mr. McDevitt; High Potential System, Mr. Leloup; Low Potential Outside Wiring and Inside Wiring, Exposed and in Special Hazards and Motors, Mr. Van Geisen; Low Potential Inside Wiring, Concealed and in Wire-ways, Mr. Low; Electric Railroads and Storage Batteries, Mr. Fitzgerald; Automatic Fire Alarms and Inspection and Policy Forms, Mr. Merrill; Test and Approval of Devices and Material, Mr. Cabot; Alternating Systems, Arc Lighting on Low Potential Systems, Electric Gas Lighting, Municipal Fire Alarms and the Press, Mr. Goddard.

A sub-committee of five was appointed, to whom were referred a number of subjects for final consideration, which it was found impossible to consider fully at these meetings without prolonging them beyond the time planned for. The sub-committee consists of Messrs. Cabot, Low, Merrill, Fitzgerald and Van Geisen. This committee will hold a meeting in Boston, probably in the Assembly Room of the Exchange, on Tuesday, Sept. 5th, continuing in session until all these matters are disposed of. After the work of this committee is completed the recommendations of the full committee and the sub-committee will be sent to the various Boards of Underwriters, and, presumably, adopted as amendments and additions to the rules now in force.

PERSONAL.

MR. CLARENCE E. STUMP.

WE take great pleasure in announcing that Mr. Clarence E. Stump, formerly vice-president of the Street Railway Publishing Company and business manager of the *Street Railway Journal*, has associated himself with the *Street Railway Gazette* as its president and general manager, and will in future devote his entire time and attention to the business department of this paper. Mr. Stump is already well known among street railway and electrical people through his long connection with the business management of the *Electrical World* and the *Street Railway Journal*, and his successful career in the management of those journals is a sufficient guarantee that his connection with the *Gazette* will be of the greatest value to our patrons. We are pleased to announce also that we have secured the services of Mr. J. W. Dickerson, who will hereafter be associated with Mr. Edward Caldwell in the editorial management of the *Gazette*. Mr. Dickerson is an experienced newspaper man and is well-known as a writer on street railway and electrical subjects, having been connected at different times with the editorial staff of the *Street Railway Journal*, the *Western Electrician* and *Electricity*.—*Street Railway Gazette*.

THE FRISBIE ELEVATOR AND MANUFACTURING COMPANY.

AT least one concern in this city, says the *New Haven Weekly Record*, is not affected by the industrial depression. It is the Frisbie Elevator and Manufacturing Company, corner of Ashmun and Admiral streets. This company is not only busy, but it has more orders than it can readily fill, and it is obliged to enlarge its plant to accommodate its increasing business.

As announced at the time the Frisbie Company was reorganized recently, the present officers are these: president, J. B. Wallace, of Ansonia; vice-president, S. M. Munson, of New Haven; secretary and treasurer, Geo. W. La Rue, of New York; superintendent, W. M. Frisbie, of New Haven; sales agent, C. E. Corwin, of New Haven. The active officers are all practical men who thoroughly understand the business, and under their management the company is destined to become an important industry for New Haven. Mr. La Rue, the new secretary and treasurer, is well known in electrical circles, having been prominently connected with Edison, Thomson-Houston, Crocker-Wheeler Co.'s, and recently with the Ansonia Electric Company at Chicago.

The Company has made some important improvements in electric elevators, and one of these machines at the World's Fair has attracted wide attention. Last week it made 3,323 trips and carried no less than 12,966 people. It is of ten h. p. and is located in the Electricity Building.

Since special attention has been paid to these electric elevators, orders have come in very rapidly, and more room for assembling the parts was necessary. An addition for this purpose is now being built. As soon as possible in the fall a big building of brick will be erected on Ashmun street on property recently purchased north of the present factory. This building will be 95 by 150 feet and two stories high. As rapidly as may be the old buildings will changed to brick, and one of the finest elevator plants in the country will be established.

THE ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS.

LIKE a gleam of strong sunshine through clouds comes the announcement of the fifteenth annual clambake given to the electrical community by the American Electrical Works. It will take place at Haute Rieve, Providence, R. I., on Saturday, September 2, lunch being served at 11.30 and the bake being opened at 2. The honorary and reception committees are well manned, and, as everybody knows, the preparations are all that hospitality and friendship could suggest.

CHAUDIERE ELECTRIC LIGHT COMPANY, OTTAWA, CAN.

THE CHAUDIERE ELECTRIC LIGHT COMPANY, Ottawa, have placed an order with Messrs. Goldie & McCullough Company, of Galt, Ont., for two tandem compound Wheelock engines of 600 h. p. each, and six steam boilers with a capacity aggregating 1,800 h. p., for use in the auxiliary steam station which the Chaudiere Company are about building. This new station will have one of the tallest chimneys in Canada. It will be 120 feet. This extreme height is a safeguard against flying sparks, the station being in the immediate neighborhood of the lumber piles. Experts say that a spark from pine wood carried up a chimney to the height of 80 feet loses its power for mischief, and the company is going to erect its chimney 40 feet higher still in order to make assurance doubly sure.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUGUST 8, 1893.

Accumulators:—

Secondary Battery, L. Morse, Brooklyn, N. Y., 502,834. Filed July 25, 1892.
Electrodes built up of strips of lead of different thicknesses, folded zigzag.

Alarms and Signals:—

Electrical Railway Signal, B. C. Seaton, Nashville, Tenn., 503,100. Filed March 2, 1893.
Automatic block signal system with locomotives electrically equipped to operate system.
Fire Alarm Apparatus, S. W. Ludlow, Madisonville, O., 502,731. Filed Nov. 1, 1892.
Fire alarm utilizing the gas pipe system in a building in connection with an electric circuit.
Synchronism Indicator, L. Bell, Boston, Mass., 502,695. Filed Dec. 24, 1892.
Apparatus for indicating synchronism or lack of synchronism between two or more alternating current machines by means of sound waves answering in periodicity to the current waves of such machines.

Clocks:—

Electric Alarm Clock, W. H. Deane, Brooklyn, N. Y., 502,811. Filed Dec. 15, 1892.
Provides for prolonged ringing of the alarm.
Self-Winding Electric Clock, F. M. Schmidt, Brooklyn, N. Y., 502,935, Filed Jan. 19, 1893.
Improves the means for winding the main spring and insures the proper breaking of the circuit as soon as the spring has been wound sufficiently.

Dynamos and Motors:—

Alternating Electric Current Generator, S. Sheldon and J. J. Rooney. Brooklyn, N. Y., 502,777. Filed Sept. 28, 1892.
Improvement in winding.
Regulator for Electric Generators, E. Thomson, Swampscott, Mass., 502,788. Filed May 23, 1892.
Regulates by rendering ineffective or active, alternately, sections of the field winding of an exciter machine, which feeds the field magnets of an alternating generator.
Armature and Method of Constructing Same, H. F. Parshall, Lynn, Mass., 502,988. Filed April 10, 1893.
Provides means for securing the core of an armature to its spider.
Regulation of Alternating Current Motors, M. von Dolivo-Dobrowolsky, Berlin, Germany, 503,038. Filed Dec. 23, 1890.
Claim follows:
In an alternating current motor, the combination of a field magnet provided with three or more coils or set of coils, a like number of circuits connected to the said coils or set of coils, means for supplying the circuits with differential phase alternating currents, a rotative armature having coils or set of coils which are independent of each other, adjustable resistances equal in number to that of the coils or set of coils of the armature, contact rings on the armature, brushes and conductors whereby each coil or set of coils of the armature is separately brought in circuit with one of the resistances, and a regulating mechanism common to all the resistances.
Armature for Dynamo Electric Machines and Motors, S. S. Wheeler, New York, N. Y., 503,106. Filed April 24, 1893.
Claim 1 follows:
An armature for electric motors and dynamos, the core of which is made up of two parts, each composed of laminations of unequal lengths of arc, the longer laminations overlapping the shorter ones at both ends, and the long and short laminations of one part being complementary in lengths of arc to the short and long laminations respectively of the other part, and reversed in position relatively thereto, so that the two parts fit together with a mortise joint and the laminations form complete rings when the parts are fitted together.

Electrolysis:—

Apparatus for the Electrolytic Manufacture of Tubes, A. S. Elmore, Leeds, Eng., 503,076. Filed Sept. 21, 1892.
Slight modification in the original Elmore process of depositing copper and causing a burnishing tool to travel over the surface of the metal.

Lamps and Appurtenances:—

Incandescent Electric Lamp, J. H. Bates, Hoboken, N. J., 503,108. Filed Jan. 19, 1893.
Lamp with stopper parts to permit filament renewal.
Electric Arc Lamp, L. H. Buchanan, Pasadena, Cal., 502,948. Filed Sept. 25, 1891.
Mechanism for the better utilization of disc-shaped electrodes. The disc-shaped regulating armature is subjected to the influence of a series of concentrically exposed magnetic poles, so that it shall rotate in obedience to the magnetic influence of the surrounding magnets and regulate according to the feed of the carbons.
Electric Lighting System, C. C. Chesney, Pittsfield, Mass., 502,702. Filed April 3, 1893.
Interpolates in an arc lighting alternating current circuit a condenser with each lamp of such capacity as to neutralize the self-induction of said lamp and prevent the extra drop in E. M. F., permitting the operation of incandescent lamps.

Measurement:—

Circuit Testing Apparatus, F. S. Palmer, Boston, Mass., 502,889. Filed March 20, 1893.
Claim 1 follows:
In circuit testing apparatus, a continuous outside wire common to all floors, a group of inside wires, one for each floor electrically arranged in multiple, combined with a switch adapted to change such systems of wires from multiple to series in the act of testing.

Miscellaneous:—

Electric Belt, J. H. Se Cheverell, Jefferson, Ohio, 502,776. Filed June 15, 1892.
Electric Body Wear, W. H. Payne, Philadelphia, Pa., 502,753. Filed Feb. 18, 1893.
Electric Belt, D. P. Andrus, St. Louis, Mo., 502,804. Filed Oct. 31, 1892.
Circuit Closer, A. J. Oehring, Chicago, Ill., 502,749. Filed Feb. 7, 1889.
Relates to push key mechanisms.
Electrode for Firing Explosives, J. N. & H. J. Harrison, San Francisco, Cal., 502,965. Filed June 8, 1892.
Electrically-Operated Hydraulic Elevator, E. Marshall, Boston, Mass., 502,981. Filed Nov. 19, 1892.
Electric Switch, J. H. McEvoy, Waterbury, Conn., 502,983. Filed Dec. 31, 1892.
Combines rotary contacts of special disposition with positive actuating mechanism and an escapement or intermittent stop mechanism.
Electric Igniting Device for Gas Engines, F. E. Tremper, New York, N. Y., 503,016. Filed Feb. 8, 1893.
Design for an Insulator, L. B. Gray, Boston, Mass., 22,884. Filed June 22, 1893.
Electric Switch, L. Morse, Brooklyn, N. Y., 502,835. Filed August 22, 1892.
Longitudinally movable bolt or contact carrier, acting positively.

Railways and Appliances:—

Subway for Electric-Railway Conductors, I. LaR. Johnson, Washington, D. C., 502,831. Filed Oct. 10, 1890. (See page 200.)
Combines the railway conduit with one rail, the conduit conductor support being bracketed to the cross-ties.
Electric Railway Conduit, R. R. Zell, Baltimore, Md., 502,842. Filed August 8, 1892. (See page 201.)
Combines continuous drain pipes with the trolley conduit.
Trolley-Wire Insulator, L. McCarthy, Boston, Mass., 502,826. Filed March 27, 1893.
Improvement on Patent No. 449,943.
Supply System for Electric Railways, W. F. Jenkins, Richmond, Va., 502,558. Filed June 3, 1892. (See page 200.)
Feed wire bared at intervals and placed alongside rail so that current may be taken up by contact devices on car.
Conductor Support and Insulator, W. B. Essick, Manley, Neb., 503,039. Filed Feb. 1, 1893.
Vertical insulator for carrying underground trolley wire.
Electric Rail Bond, B. C. Seaton, Nashville, Tenn., 503,101. Filed March 2, 1893.
Rail bond entirely concealed and protected by the fish plates, and consisting of a number of elastic rods.

Telephones and Apparatus:—

Test Circuit for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 502,768. Filed Dec. 27, 1886.
Improvement on system of telephone test circuits shown in patent No. 305,021.
Lock Switch for Electric Switchboards, C. E. Scribner, Chicago, Ill., 502,769. Filed Nov. 19, 1887.
Intended for multiple switchboard systems.
Telephone Exchange Apparatus, C. E. Scribner, Chicago, Ill., 502,770. Filed Oct. 15, 1888.
Its object is to reduce the number of switches heretofore used in multiple switchboard telephone exchanges.
Transfer System for Switchboards, C. E. Scribner, Chicago, Ill., 502,771. Filed Oct. 27, 1890.
Test Signal for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 502,772. Filed Feb. 24, 1891.
Testing System for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 502,773. Filed June 29, 1891.
Test Circuit for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 502,774. Filed July 7, 1891.
Testing Apparatus for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 502,775. Filed August 1, 1891.
Multiple Switchboard System, C. E. Scribner, Chicago, Ill., 503,099. Filed Oct. 13, 1891.

LITERATURE.

The Infringement of Patents for Inventions, Not Designs. By Thos. B. Hall, of the Cleveland Bar. *Cincinnati.* Robert Clarke & Co. Calf. 275 pages. Price, $5.

THIS is a useful work devoted to the legal aspect of patents and deals solely with the opinions of the Supreme Court of the United States. In other words, it is Supreme Court doctrine, carefully analysed, not interpreted or in any wise subjected to personal discussion. There are four divisions, namely, license under the patent, identity of the invention, validity of the patent, and recovery for infringement. The body of judicial opinion here presented is of the first importance and value, and the growth of that body, as elucidation is advanced from point to point by decisions of the Court, is most interesting. The feeling one has in looking over such a collection as this is that of regret at the absence of a full international understanding or agreement on these conditions that govern property in invention, so that to-day patents might at least be as well protected as copyrights.

Electric Lighting and Power Distribution. Part 3. Final. By W. Perren Maycock. *London.* Whittaker & Co. 70 Illustrations. Paper. Price, 75 cents.

THIS is the third part of an admirable work, intended as an elementary manual for preparatory students. The previous sections have already been commented on in these columns. It deals with sources of supply, methods of distribution, regulation, protection and measurement. On the whole, it is very satisfactory, though the attempt to cover large subjects in a couple of pages is necessarily open to objection. The way in which Mr. Tesla's work is treated, for instance, is curious. We are told of "M. Tesla's wonderful experiments;" we are next informed that "M. Tesla's experiments contained nothing new to scientific men," and then equal space is given to Mr. Swinburne's clever little variations on one Tesla theme. We would suggest that Mr. Maycock inform himself as fully on Nikola Tesla's work as he has on that of other good American citizens whose prefix is also plain "Mister."

These paper-covered books are to be put together in one cloth bound volume accompanied by their excellent index. We are glad to note this, and would only suggest that in America the book would be better adapted to the market if it had more to say about electric railways than a mere incidental reference to the Liverpool road.

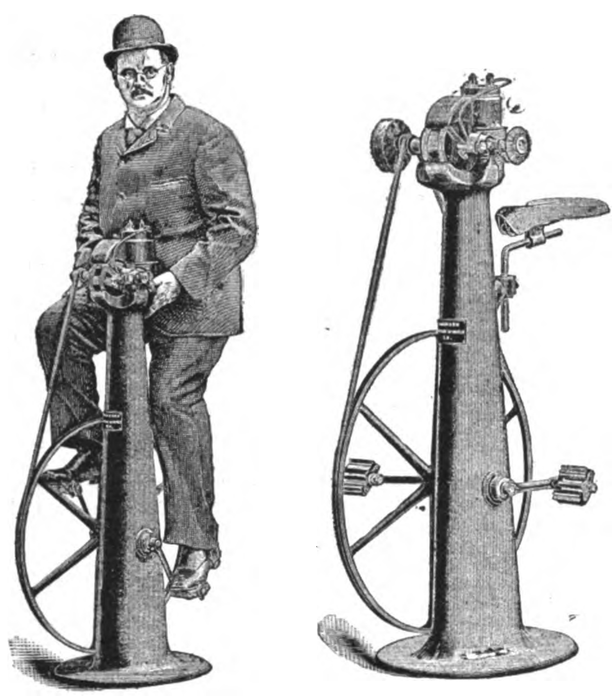
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE HANSON & VAN WINKLE BICYCLE-PLATING DYNAMO.

We illustrate herewith a highly novel and ingenious plating machine, and method of operating it, just put upon the market by the Hanson & Van Winkle Co. As will be observed, the propelling mechanism is that of a bicycle put upon a standard, and not only is the dynamo driven in this way, but the buffer attachment is similarly operated, dispensing with the necessity of a separate buffing lathe. It seems to us that jewelers, bicyclers, students, experimenters and small platers will delight in the convenience and economy of such an appliance as this.

The dynamo is a regular machine, similar in construction and principle to the larger machines of Hanson & Van Winkle manufacture, and of high efficiency. It consists of a dynamo cast upon an iron pedestal of graceful proportions, with an arm extending for the support of the saddle and hubs in which the main bearing runs. There is the shortest possible magnetic circuit and one field coil. One end of the pole is cast solid to the magnet



Figs. 1 and 2.—Hanson & Van Winkle Bicycle-Plating Dynamo.

core, the other cast on a taper, keyed and bolted. The poles have extended arms, which, after being bored and the boxes turned to the same diameter and bolted into place, insures perfect alignment for the bushings in which the armature shaft runs. Every part of the machine upon which wear comes is made in duplicate, and is easily exchanged for new parts.

This machine has a regulation bicycle saddle with spring adjustments and an adjustable saddle post, allowing a child or the tallest man to do the work with perfect satisfaction. There are, also, ball-bearing rubber pedals, regulation bicycle cranks and crank-pins. These are all nickel plated, showing work that can be done on this machine.

If at any time power becomes available from any other source, and the increase of trade demands it, a belt can be run direct to the small armature pulley, and the owner has a regular dynamo, with stand, buffing lathe, and all, complete, at a less price than it is possible to obtain the same combination without the foot power.

The buffing machine has taper holes, chucked into both ends of the shaft of the armature. It has one taper mandril, with nut that will hold various buffs, muslin, etc.; has, also, taper screw mandrils that will allow of the holding of brushes, felts, polishing rolls, etc.—in fact, with these spindles, all the buffing and polishing wheels can be held to do the work. This machine not only is a dynamo, but is a buffing lathe as well, combining the two required machines for plating.

It is stated, to give an idea of the capacity of the machine, that it will plate a dozen knives and forks with a triple coating of silver in 20 minutes. Hanson & Van Winkle have fully secured the features of invention in this useful contrivance by letters patent.

IMPORTANT NIAGARA PLANS OF THE PITTSBURGH REDUCTION COMPANY.

Mr. Alfred E. Hunt, president of the Pittsburgh Reduction Company, writes us as follows with regard to the removal of his plant to Niagara Falls, N. Y.:

"We are now getting out details and plans for our new plant, which we expect to have in operation about the 1st of February, 1894, at the time that the Niagara Falls Power Company agree to furnish us with the electrical current. The units of the current will be in blocks of at least 7,000 to 8,000 amperes each. We are now preparing plans for a brick building, 200 feet long and 70 feet wide in which the electrolytic process for the manufacture of aluminum goes on. The transformation of the current used will be in an iron building of about 100 x 70 feet, and there will be three other buildings used for storage and the like, of about 70 feet span and 100 to 150 feet in length each. The site that has been located is a block of about four acres of ground situated some half a mile up the river from the main power station of the Niagara Falls Power Co."

RECENT INSTALLATIONS OF BALL ENGINES.

The Buffalo, Bellevue & Lancaster Railway, Buffalo, N. Y., have been so well pleased with the performance of their first engine, a 150 h. p. Ball, that they have recently purchased another of the same size from the well-known makers, the Ball Engine Co., Erie, Pa. The Waddell-Entz Co., Bridgeport, Conn. have recently given an order to J. H. Houghton, Boston, representative of the Ball Engine Co. for one 100 h. p. direct connected engine. Harlan & Hollingsworth, Wilmington, Del., have added another 150 h. p. Ball engine to their plant. J. W. Parker & Co., Philadelphia representatives of the Ball Engine Co., supplied these engines. Messrs. Cooley & Vater, of Minneapolis, representatives of the Ball Engine Co. are installing two 200 h. p. Ball cross compound engines, directly connected to Siemens & Halske generators, in the Lumber Exchange Building, Minneapolis. The combination is certainly a very handsome one and attracts considerable favorable attention.

ACTIVITY OF THE BERLIN IRON BRIDGE CO.

In times like these when almost every manufacturing concern is complaining of hard times and lack of orders it does one good to find that there is occasionally a concern which is running full time has plenty of orders. The Berlin Iron Bridge Co., of East Berlin, Conn., are full of orders and are running their entire plant full time and portions of their work overtime. They have contracts for a large amount of work including a new electric light and power station at Lynn, Mass.; a drawbridge at Salem, Mass.; a new foundry building for the New Home Sewing Machine Co., at Orange, Mass.; an iron building to go to Tampa, Fla.; a large bridge for Chester County, Pa.; a new iron storehouse for the New York Knife Co., at Walden, N. Y.; a large power plant for the Philadelphia Traction Co., of Philadelphia; a large cotton shed for the Southern Pacific Railroad Co., at New Orleans, La.; a new roof for the purifier house of the Northern Liberties Gas Co., at Philadelphia, Pa.; a new power house for the Reading Traction Co., of Reading, Pa.; a new power house for the State Street Horse Railway Co., at New Haven, Conn.; a car barn for the Easton Transit Co., at Easton, Pa.; a large smelter building for the Anaconda Smelting Co., at Anaconda, Montana. Besides these they have numerous small jobs scattered throughout the country which will employ their entire plant until after the 1st of January. The Company is to be congratulated on securing work like this at this time,

WORLD'S FAIR PRIZE WINNERS EXPOSITION.

It is proposed to hold at the Grand Central Palace, next February and March, under the management of the Manhattan Industrial Exposition Company, of 122 West 23d street, a Fair under the above title. It is intended to secure as many of the prize exhibits at Chicago as possible, and make these the basis of a fine show. The floor space will be cheap and the admission fee will only be 25 cents. The idea is a good one, and will afford New Yorkers an opportunity to see some of the best features of the great show in Chicago, without the expense of going there. A number of well known public-spirited citizens including Postmaster Dayton, Register Levy, and City Chamberlain O'Donohue, are interested.

The Hicks-Troy Electric Door Co., has been formed at Chicago, with a capital stock of $250,000, to make electric doors and door operators. The incorporators are O. H. Hicks, R. F. Troy and R. McMurdy.

THE
Electrical Engineer.

Vol. XVI. SEPTEMBER 6, 1893. No. 279.

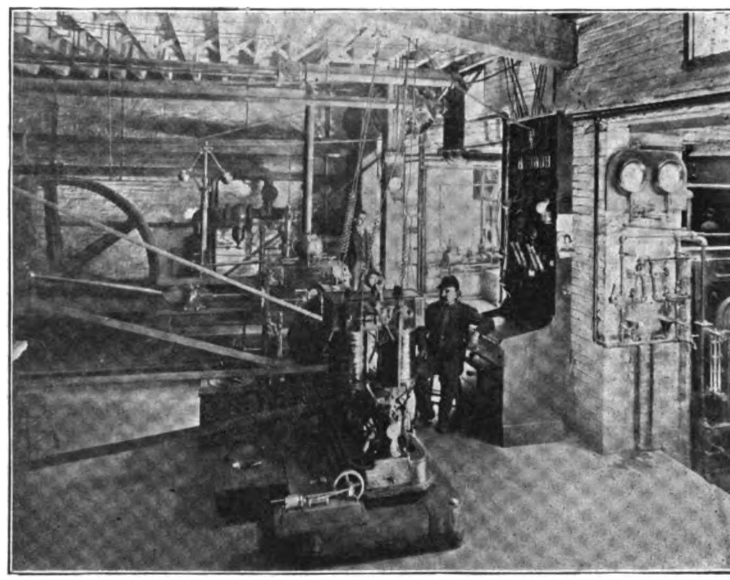
ELECTRICITY AT THE HEBREW TECHNICAL INSTITUTE, NEW YORK CITY.

THE reproach has often been heard that the Jews are a race of traders and that they have studiously avoided all manual labor. If this reproach has been a just one in the past it certainly cannot be deemed so at the present moment, when we find Jews taking up the various mechanical industries and attaining a success in them far beyond the measure which the lack of hereditary training would lead one to believe was possible. It is this very lack of inherited skill which has been recognized by a number of philanthropists in this city, who, some ten years ago, under the leadership of Mr. James H. Hoffman, banded together and founded the Hebrew Technical Institute From small beginnings this establishment has now acquired a well recognized position among the technical training schools of the country, and the results already obtained more than bear out the most sanguine hopes of its founders.

The Institute which occupies the buildings 34 and 36 Stuyvesant street, New York, partakes of the nature of a trade school, a manual training school and a polytechnic institute, without belonging distinctively to any one of these classes. The object sought is to train boys so that after graduation they are prepared to take up any trade to which they may take a fancy, with the mind and hand thoroughly prepared for their work. The boys are taken in at the age of not less than 12½ years and pass through a three years' course embracing the lower branches of mathematics, English, physics, drawing, etc. Special attention, however, is devoted to shop work, the Institute having fully equipped machine and wood working shops in in which the students spend fully one half their time while at the Institute.

ELECTRICAL LABORATORY, HEBREW TECHNICAL INSTITUTE.

During the second year, current electricity and magnetism are taken up, and oral, written and practical exercises are required of the students. In the third year the study of electricity is continued, the telegraph, telephone, lighting and transmission of power being taken up. In that year also special courses are provided in mechanical drawing, wood working, metal working and practical electricity. The course in practical electricity consists of lectures and recitations, to which two hours per week are devoted, and to these are added experimental work of eight hours per week in the laboratory. The work gone through embraces exercises in magnetism, primary and storage batteries, dynamos, motors and lamps, electrical testing and the construction of apparatus for use in demonstrations and experiments. Our engraving, Fig. 1, shows the electrical laboratory at the institute. Here the students work in pairs. A typewritten copy explaining the experiment to be made is given to them, indicating the necessary apparatus to be used; after reading the explanation carefully they proceed to work, noting each effect as it is produced. When the experiment is finished, books of reference are consulted and a record made in note-books with pen and ink, and illustrated by sketches. The equipment of the electrical laboratory contains a 6-coil tangent galvanometer, small models of the Weston, Gramme, Siemens and Manchester dynamos; Thomson, Deprez and D'Arsonval galvanometers, Wheatstone bridge, magnetometer, a standard cell, condensers, etc.



DYNAMO ROOM, HEBREW TECHNICAL INSTITUTE.

In addition to the regular laboratory work, the students are thoroughly instructed in the handling of a dynamo

plant, the building being lighted throughout by electricity. This plant contains a 100 ampere Edison machine and a Desroziers 220 ampere machine,—the first of its kind in the country,—a set of accumulators and a complete equipment of indicating instruments. The dynamo plant is illustrated in Fig. 2.

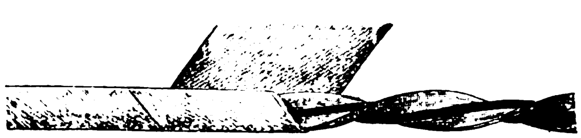
The electrical course is in charge of Mr. W. Wallace Kerr and the success met with by the students graduated from the Institute is evidence of his careful and intelligent instruction, as well as of the general excellence of the training which the Institute gives its pupils.

The exhibit of the Institute in the Anthropological Building at the World's Fair contains a complete display of its work, including a dynamo of the Edison type and a variety of other electrical apparatus, all of which was built by the students in the shops of the Institute.

NEW FELTEN AND GUILLEAUME TELEPHONE CABLES.

The recent discussion on improved telephone cables for long distance work, and especially for oceanic submarine service, gives interest to any attempt at improvement which promises definite results. The problem has been mainly that of devising telephone cables in which the static capacity is reduced to a minimum, thanks to the nature of the insulation. Mr. Emil Guilleaume, of Felten and Guilleaume, Mulheim, Germany, discussed this question recently before the Engineering Congress at Chicago and submitted some new telephone cables of great interest recently brought out by his house. A cable, he remarked, in which the conductors were surrounded by air would, normally, give the best results as far as static capacity is concerned; but as the conductor cannot be kept central without a support of some sort or other, the best cable would be such in which the conductor was kept central in a pipe filled with air by the aid of the least voluminous supports, the latter composed of a material of the lowest possible static capacity, or in which the conductor itself was of such a form as to touch the insulating shell (pipe or tube) with the least possible portion of its surface; either twisted wire with a triangular, rectangular or star-shaped section, or corrugated or zigzag wire.

The other alternative has been tried in various ways, viz.: *a.* By filing beads of wood or ebonite or glass on the conducting wire. *b.* By winding a line of thread or cord around the conductor in an open spiral so as to leave plenty of air space between the windings. *c.* By serving the conductor with an open braiding of cotton thread or cord. *d.* By interbraiding the several conductors with cotton thread, thus keeping them separate from one another by the thread and forming air spaces between them. *e.* By providing air spaces in the insulating material (mostly paper tape), by curling or frilling or perforating

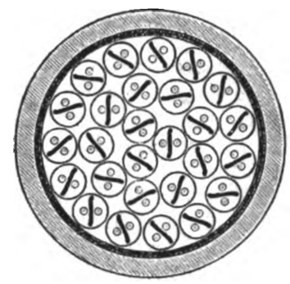


CABLE WITH TWO CONDUCTORS.

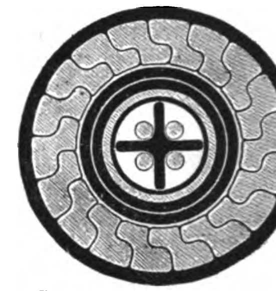
or embossing the same. *f.* By twisting a strip of nonconducting material about its own axis to form grooves or air channels in which the conductors lie.

This last named way of solving the problem was the invention or method adopted by his firm whose patent lead cable with paper insulation and air spaces, has given, he said, the best results, the static capacity being reduced to 0.06 microfarad per statute mile at a temperature of 60° F., whereas with other cables of the same proportions the capacity would be 0.48 microfarard with india rubber, 0.16 microfarad with fibre insulation, and 0.08 (lowest) with the ordinary paper insulated cables. Thus one can speak through a cable with paper and air insulation over a correspondingly longer distance with the same clearness of sound. This arrangement at the same time allows of the smallest diameter of the cable, and each core is easy to trace.

Another important factor in judging of the value of a telephone cable is the absence of induction, the presence of which is the cause of the most annoying cross talk.



CABLE COMPOSED OF PAIRS OF CONDUCTORS.



SUBMARINE TELEPHONE CABLE.

The best and safest way of overcoming this difficulty will be the introduction of metallic circuits—*i. e.*, to do away with earth connection and provide two cores in the cable for each subscriber. However, this for one reason or another cannot be done in all cases, and where only single conductor cables can be used, provisions will have to be made to reduce the disturbing influence of induced currents to a minimum. This problem has been more or less perfectly solved in different ways, viz.:

a. It has been proposed to cross the cores at given intervals in the cable or in the cable joints, similar to what is done on aërial lines for the same purpose. This complicates the manufacture of the cables materially and attains the desired object but imperfectly. *b.* Another way of making the cores cross one another at as near as possible a right angle has been proposed by twisting two cores together in very short windings. *c.* The same leading thought has been instrumental in the invention of the solenoid (Lugo) cables, in which a portion of the cores are wrapped round the others. *d.* The most effectual way of doing away with the annoying influence of induced currents is a wrapper of tinfoil around each core and the provision of one or more earth copper wires between the cores.

The wrappers of tinfoil collect the induced currents, and, as they are in metallic connection with one another and with the earth wires, the latter need only to be connected to earth in order to remove the induced currents. It must not be overlooked, though, that the wrapper of tinfoil increases the static capacity.

Worth mentioning is the 28-core telephone cable adopted by the German postal authorities. This cable can be used as a single conductor as well as for metallic circuit. To that end the 28 cores are arranged in seven groups, each of four cores. The conducting wires are insulated with impregnated fibre, and each core has a serving of tinfoil. The four cores of a group are stranded around a non-insulated copper earth wire. These cables have given excellent results, and the firm have recently constructed telephone cables on the same principle with their patent paper and air insulation, a thin copper strip being inserted in the cross-shaped paper stay to collect the induced currents and lead them off to earth. They have also introduced a form of locked wire sheathing in connection with their submarine telephone cables, for air spaces. Such sheathing keeps off any strain or pressure from the core, which is enclosed in a non-compressible tube.

MR. J. T. KING has been appointed chief engineer of the Alton, Ill., Electric Street Railway Co.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XVI. NEW YORK, SEPTEMBER 6, 1893. No. 279.

STORMS AND OVERHEAD WIRES.

DURING the past fortnight the Eastern portions of the United States have been visited by two tremendous storms of West Indian origin, whose path along the coast and across the country has been marked by the destruction of property and loss of life on a scale that helps us to look disdainfully on any report of Western cyclone ravages. One of the features of these storms has been the general suspension of telegraphic service, so much so, that at this moment, a week after the latest gale, work is still in progress on the broken Western Union wires near New York. All around the great cities the network of wires went down, and between such centres as New York, Boston, Washington and Chicago communication was entirely interrupted. As in the time of the great blizzard, New York telegraphed to Boston by way of Europe.

The natural result of this condition of affairs is that an outcry is at once raised for at least arterial underground wires between the great centres; and there is some reason in the public clamor. At the same time, it may be pointed out that the staunchly built long-distance telephone lines have survived where the weaker telegraph lines have succumbed, and that before going in for expensive underground work, it would be well to investigate the causes of the stability of the telephone lines. Aside from that, and for general reasons of public safety, it would be well if the Government had at its command, as the German government has, some underground lines between distant points of importance, likely to remain free from interruption by any cause whatsoever.

It seems to us that the destructive work of these storms should prove a great stimulus to the perfection of means whereby we can dispense with wires. Mr. Preece has just been showing us ways in which it can be done, and we believe that by the utilization of some of the new Teslaic ideas and methods all the difficulties of the problem would disappear. Then the winds might blow and the rains might beat, but we would still be able in the hour of peril, to know the price of pork on the Chicago Board of Trade, and to tell the country at large how Jenkins was keeping cholera away from us down New York Bay.

ELECTRICAL TEACHING AND TRAINING.

WE publish in this issue an abstract of Prof. Jamieson's interesting Congress paper on electrical instruction, especially that in London colleges and schools. The subject is one of the greatest importance, and has been frequently touched upon in these columns, in articles dealing with American educational work of the same kind in colleges and universities, and even in such modest places as the Hebrew Technical Institute, of which we give an account this week. Prof. Jamieson appears to have made good use of his time in London, and perhaps it is better that the description of what is done there should come from an observant outsider, than from any of the men actually engaged in the work on the spot. What we miss in his paper and what is perhaps difficult to supply, is some statement of the manner in which all this vast amount of tuition in London is graded and connected. That is really one of the main points, for unless there are regular stages of advance, the pupil is at an enormous disadvantage. In London, as we understand it, a poor boy can have practically seven years' special training, supposing that he begins from the Board schools as our boys do in the public schools. The London lad successful in winning one of the 12 scholarships open yearly to about 200,000 boys, goes to the Cowper street schools for three years. Then there are four sholarships in the next stage, at Finsbury, where he gets a higher grade of instruction for two years; and the final pick lands one boy at the Central institution where he gets, we believe, three years of what may be considered university training, evidence of whose thoroughness was given at the Congress in the observations on the arc compiled and presented by Prof. Ayrton. It does not follow, we believe, that any one of these 12 boys need select electricity as his special study, but if he does, his career is open to talent in that line as much as in any other.

THE ELECTRIC STREET CAR GONG.

THE *Elmira Gazette* remarks that five trolley lines converge at one street corner in that city and that each car is equipped with a bell and a gong, both of which are kept going at that junction for from 15 to 40 seconds. The *Gazette* considers so much noise unnecessary. So do we. It would be better to put one gong in the direct circuit at that point, and work it from the power house. There is altogether too much ringing and gonging on trolley and cable lines, and one remedy would be the enforcement of city ordinances against noise of this kind, which is not at all a necessary concomitant of improved traction. We question whether the gong on a car or the bell on a locomotive has ever prevented an accident or tended to make people more careful. Our opinion is that the puplic would be more cautious if there were no gongs. In fact, a newspaper went so far the other day as to insist that the gongs increased the number of accidents by hypnotizing people with their din and clang.

WORLD'S FAIR DEPARTMENT.

THE AYRTON AND MATHER ELECTROSTATIC VOLTMETER.

Prof. Ayrton and Mr. Mather have had at the Fair for some time an eletrostatic voltmeter designed for use

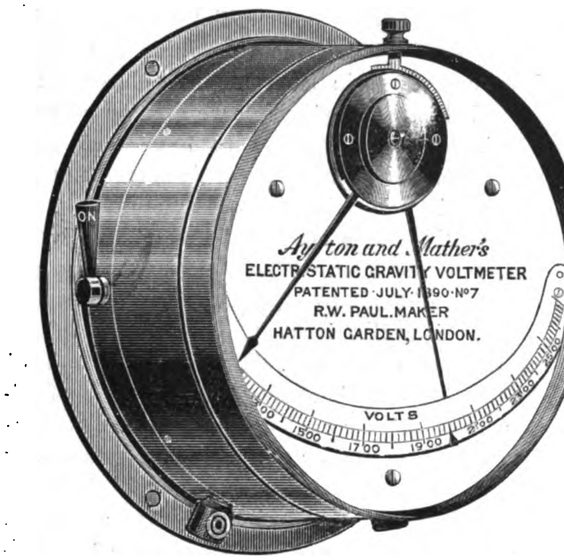
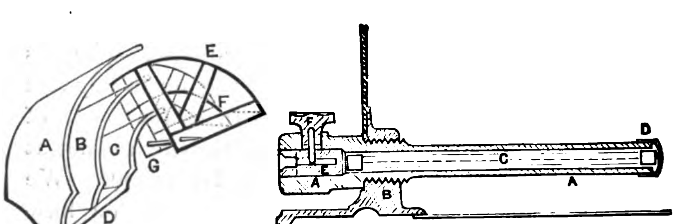


Fig. 1.

directly on high pressure mains. The instrument, unfortunately, is no more, as it was burned out during a test a few days ago, through no fault in its construction or design, but owing to a blunder in making the connections on a 2,000 volt circuit carrying a heavy current. The principle remains, however, and will be of the greatest interest to those who have been wasting power by transforming down the pressure to accommodate it to the range of a low pressure instrument.

Fig. 1 shows the voltmeter complete and Fig. 2 is a diagram of the working parts. Here A, B and C are fixed inductors like the quadrants of an electrometer. These are made of curved and rounded pieces of brass connected by a plate, D, and insulated from the case in which they are held. On the post G is fixed the needle E F, made of two thin concentric aluminum plates which are drawn into the space between the inductors by electrostatic attraction, the post being delicately pivotted on jeweled bearings. The pointer of the instrument is made to serve as a counterpoise for the needle and is normally kept at zero by a weight hung from a projec-



Figs. 2 and 3.

tion on the post. The case containing the inductors is fixed upon the back of the dial and its contents, of course, are carefully insulated. Two insulated springs, one from the inductors and the other from the inner case, make contact with the terminals. The outer case is also thoroughly insulated from the dial and the circuit.

Fig. 3 shows a section of one of the terminals encased in ebonite for additional safety. The brass block E is inserted in the ebonite shell A A, protected by an ebonite perforated plug, and tapped for the set screw F. A platinum-silver fuse .001 of an inch in diameter is contained in the elongated part of the shell connected to a metal cap at either end of a glass tube which completely encloses it and makes contact with the spring cap D and the brass block E, the former of which in turn makes contact with one of the downwardly projecting springs from the indicators and case.

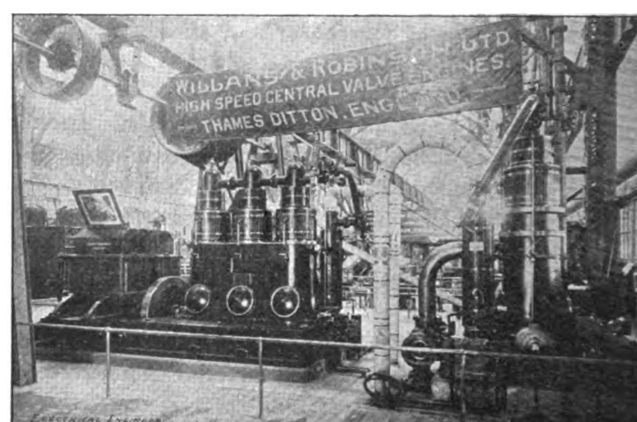
A switch, the handle of which is shown at the left of Fig. 1, is provided for cutting out the instrument from the mains by means of a cam which raises the connecting springs in the case and short circuits the needle and inductors.

The scale is large—10 inches long with a radius of six and can be easily read at a distance. The diameter of the outer case is 12 inches.

These instruments are made by Mr. Paul, 44 Hatton Garden, London, and are designed for pressures of 500, 1,000, 2,000 and 2,400 volts.

A DIRECTLY CONNECTED BRITISH PLANT IN MACHINERY HALL.

At "P, 3, Machinery Hall" is the generating plant furnishing current for the Schuckert search lights on the roof



Directly Connected Willans Engine and Siemens Dynamo.

of the Manufactures Building, and, at the same time, affording an example of typical English practice in this class of work. The engine is of the standard "I. I. I." size manufactured by Messrs. Willans and Robinson, of Thames Ditton, Surrey, England, directly coupled to a 180 kilowatt Siemens dynamo, and running at 350 revolutions a minute. The engine is of 300 indicated h. p. It has three cranks at 120 degrees apart, three 20 inch low pressure and three 14 inch high pressure cylinders and a stroke of 9 inches.

The generator is shunt wound, of the H B $\frac{24}{38}$ type and is capable of sustaining a steady current of 1,500 amperes at 120 volts with a speed of 350 revolutions and the load has been increased 20 per cent. without any sign of overheating. A test of a set exactly like this in all respects shows an efficiency of 84 per cent. at full load from the

indicated horse-power at the engine cylinders to the electrical output of the dynamo.

This combination of generator and engine has been very largely adopted in the public and private electric plants in London, and, in fact, throughout England. There are at present over 60,000 h. p. of the engines either in actual use or ordered. A consumption of less than 13 pounds of steam per indicated horse power has been recorded under favorable conditions of size, pressure, etc., and the company guarantee less than 14½ pounds with 160 pounds pressure in engines of 80 indicated horse power. The lubrication, also, is almost entirely automatic. For this particular engine only about two pints of oil a day are used, one for the engine proper and one for the cylinders.

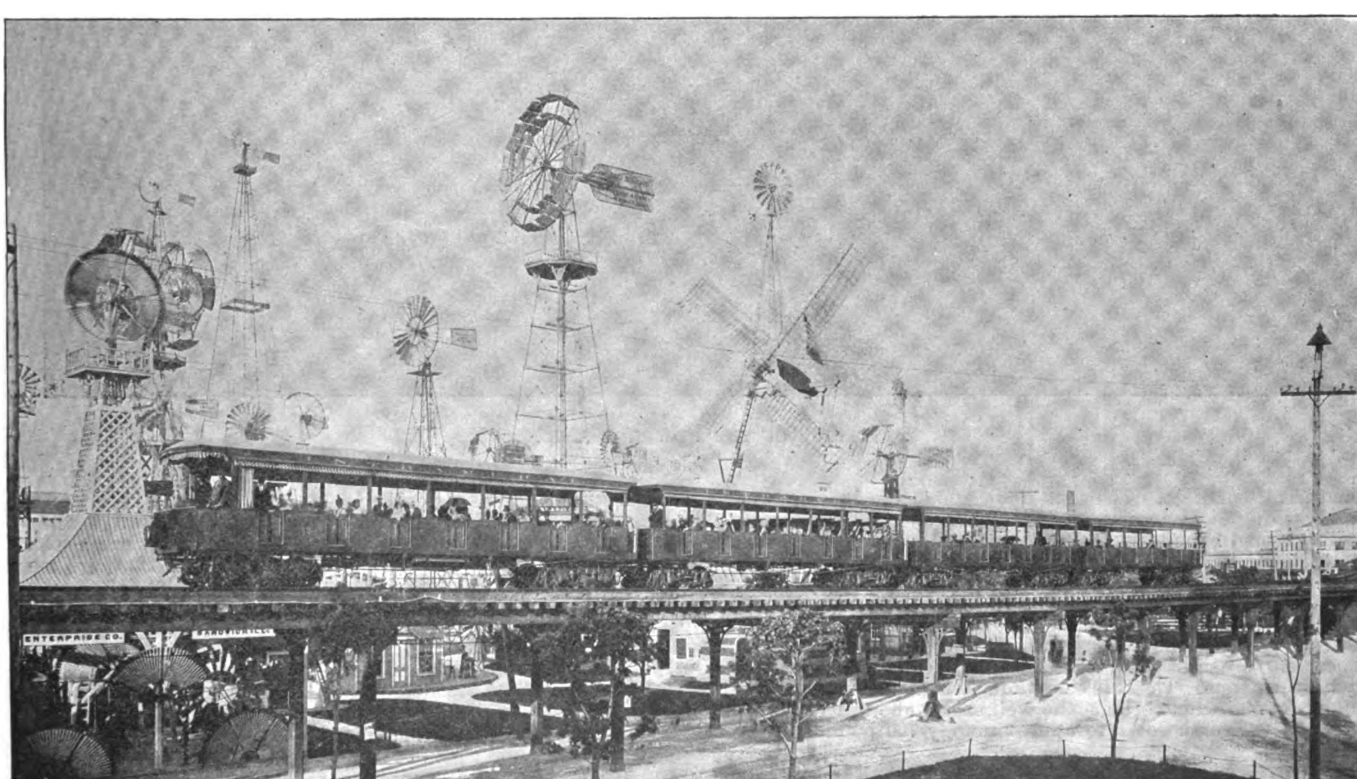
The high rotative speed at which these engines run insures great steadiness of driving. Those of 600 to 1,000 indicated horse power run at about 200 revolutions per minute, and consequently the fluctuations of speed are very small. For a given horse power the space required is also very small, and a far smaller fly wheel than usual may be employed. The engine can be dismantled and re-erected in a very short time when stopped for examination, thus reducing the expense and loss of time in overhauls and repairs, and it works equally well condensing or non-condensing, so that in case of accident to the condensing apparatus the station may still be run non-condensing without stoppage.

The magnet cores and yoke pieces of the dynamo are of solid wrought iron forgings supported by gun metal brackets bolted to the cast iron combination frame. Each bobbin is complete in itself and can be lifted off by a special arrangement of shackles at each end. Solid gun-metal terminal blocks are mounted on the top of each bobbin and connected to the brush holders by flexible conductors having a cross-sectional area of 3.2 square inches. The armature is of the Siemens drum pattern, built up of soft iron discs and stranded bars. It is 24 inches in diameter and is mounted on a six-inch steel spindle 7 feet 2½ inches long, one end of which has a solid forged half-coupling bolted to a corresponding piece on the engine shaft. The bearing at the commutator end is provided with a gun metal sleeve 13½ inches long and 7 inches in diameter slightly curved on the surface to allow a small lateral movement of the shaft. The rocking bars are supported by a cast iron ring adjusted by means of a worm and wheel and carry six brushes in all, three on either side of a commutator 12½ inches in diameter and 9 inches long, composed of 72 sections of hard drawn copper insulated with mica. The complete dynamo weighs 13¼ tons.

ELECTRIC RAILWAY DEPARTMENT.

THE INTRAMURAL ELECTRIC ELEVATED RAILWAY AT THE WORLD'S FAIR.

There are three ways by which a man may travel by land from point to point within the walls of the White City. If young and strong he may walk for the first few days of his visit until an idea of the enormous size of the grounds begins to force itself upon him, and he suddenly discovers that he has overtaxed his endurance. At this stage of the game he falls a victim to the wheel chair and is trundled about by a perspiring student at seventy-five cents an hour, the student receiving one dollar a day for his work. The third means of transportation is less wearing than the first, less expensive than the second and is absolutely the only way provided on the grounds for getting anywhere quickly.



A Train on the Intramural.

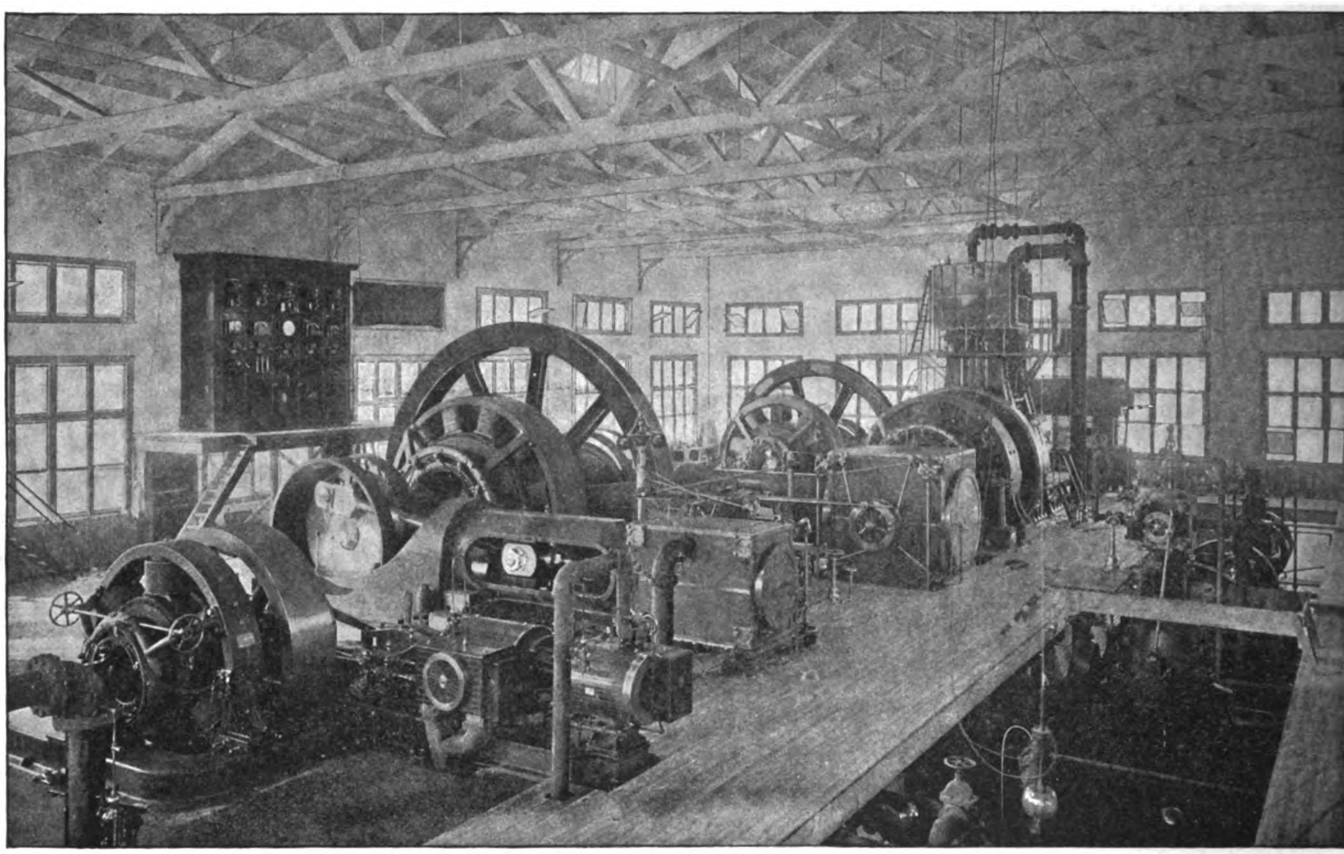
This is the "Intramural" elevated electric railway, running trains at frequent intervals on an endless track extending, for the most part along the inner edge of the Fair back of the principal buildings, that it may not mar any of the splendid views but may,

at the same time, afford convenient transportation to and from the principal buildings.

The power station of the road at the extreme southern end of the grounds near the lake front is shown in the accompanying engravings. With the exception of the wall separating the boilers from the stack the entire building is of wood and staff and is so arranged that ample space is given to visitors who wish to inspect the machinery, and each unit is completely surrounded by a railing inside of which the attendants may work without interference.

The main building containing the engines and generators is 140 feet long by 80 feet wide, inside measurement, with head room of 25 feet. The floor is 10 feet from the surface of the ground and the roof is supported on wooden trusses with 80 feet span, and 15 feet between centres, supported on pine posts one foot square with footings of 8 x 8 timber underlaid with four-inch plank. The roof is of pine, covered with corrugated iron. The boiler room, a long, narrow addition to the main building, is 140 feet in length and 49 feet wide, the floor level with the ground and the roof flat, supported by eight queen trusses, and covered with three layers of tarred roofing paper and a layer of tar and gravel.

The foundations for engines and generators are of brick on a



INTERIOR OF THE POWER HOUSE.

substructure of concrete. The sand upon which the station was to stand was dug away to a depth of 3¼ feet to get below frost, which also brought the level below the water-line and left a surface of submerged sand. This was then covered by a flooring, 185 feet long and 60 feet wide, of two layers of 3-inch hemlock placed at right angles to one another and spiked together, and on this was laid a solid block of concrete 3 feet thick and covering the entire flooring. The brick foundations were then built on the concrete to a height of 10 feet and the engine-room floor laid level with their tops. The brick was laid in cement mortar and the solidity of the whole brings the weight of about 2,800 tons supported by the earth down to approximately 700 pounds to the square foot.

In the centre of the engine-room is the great 32 x 42 x 60-inch cross compound Reynolds-Corliss engine directly coupled to a 1,500 kilowatt multipolor generator run at 80 revolutions a minute. Some idea of the size and weight of this dynamo may be gathered from the following table to weights and dimensions:

Weight of Field Magnets	80,000 lbs.
" " Armature	73,700 lbs.
" " Commutator	12,400 lbs.
" " Dynamo, complete	181,000 lbs.
Weight of Shaft and Hub	56 tons
" " Fly-Wheel	85 tons
Diameter of Generator	15 ft. 0¼ in.
Breadth of Generator	3 ft.
Diameter of Armature	10 ft. 6 in.
Breadth of Armature	3 ft. 3¼ in.
Diameter of Fly-Wheel	24 ft.
Breadth of Fly-Wheel	2 ft.
Thickness of Rim of Fly-Wheel	1 ft. 10 in.
Diameter of Commutator	7 ft. 6 in.
Diameter of Shaft	2 ft.

The machine has twelve poles, is compound wound, and is carefully insulated from the ground. The air space between the faces of the poles and the face of the armature is $\frac{7}{16}$ of an inch.

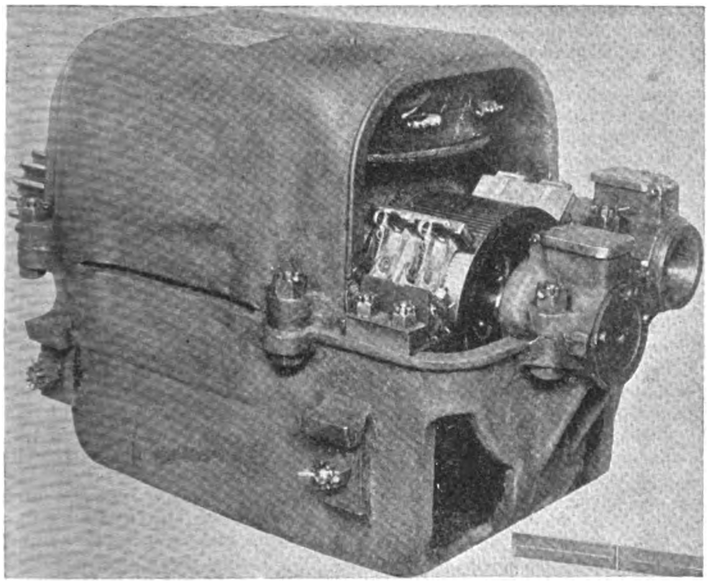
The armature is built up of sheet iron punchings set around a spider shrunk on the hub. This outer face of the spider is slotted as are the inner faces of the armature punchings, so that they dovetail together. Each circle of sheet iron is carefully insulated from the preceding one, except at one point, and this results in giving to the armature a spiral construction. Not less than 17,200 pieces of sheet iron weighing 25 tons, were used to build up the nine sheet iron sections, separated from each other by eight brass open rings, resembling spoked wheels, which serve for ventilating purposes. Two 4-ton cast iron washers held together by bolts, complete the material composing the armature core.

The winding of the armature consists of copper strips 3¼ inch wide by a ¼ inch thick, two turns to the coil. These are carefully insulated from each other by mica, and each couple is inserted into one of the 348 slots in the laminated armature body, each of which is itself lined with a mica tube. The strips are held in place by means of a wooden wedge. The side connections are then rivetted and soldered to the strips and are brought down to the massive copper commutator. There are twelve brushes, which are manipulated by means of a hand wheel actuating a gearing concealed beneath the floor of the power house.

The engine is a cross compound Reynolds-Corliss, constructed by E. P. Allis & Co. of Milwaukee, and has a capacity of 2,400 H. P. Its two cylinders are set on each side back of the generator, the high pressure cylinder having 32 inches diameter and the low pressure 62 inches. Each crank disc is seven feet four inches in diameter, one at each end of the shaft, and the length of the stroke is five feet. The fly wheel is built up in ten sections, bolted

together by dumb bell shaped pieces. It is clutched to the shaft by a special clutch.

West of this machine is a 20 x 38 x 48 tandem compound Green engine built by the Providence Steam Engine Company,



General Electric Motor Used on the Intramural Railway.

running at 100 revolutions and belted to a 500 kilowatt multipolar generator. The belt is 48 inches wide and is provided with an Eclipse tightening pulley. Near this is a 13 x 23 x 22 tandem compound McIntosh & Seymour engine driving a directly coupled 200 kilowatt multipolar generator at 150 revolutions a minute. At the other end of the room is a 22 x 42 x 48 Reynolds-Corliss tandem compound directly coupled to a 500 kilowatt multipolar generator running at 80 revolutions; and nearby a 22 x 44 x 36 Hammond-Williams cross compound vertical engine built by the Lake Erie Engineering Works, of Buffalo, and running at 100 revolutions, drives a directly connected multipolar generator of 500 kilowatts capacity.

The switchboard is of enameled slate framed in mahogany. It is composed of five panels, one for each machine, each panel containing all the instruments necessary for the control of the machine to which it belongs, *i. e.* triple pole switches, shunt rheostats, ammeters, automatic circuit breakers, lightning arresters, lightning switches, etc. The circuit breakers are of the new design of the General Electric Co., and are provided with automatic resetting devices which close them electrically. With this electrical reset, all or any desired number of circuit breakers in the station can be reset at once. The generators are adjusted so to run in perfect harmony as exactly to divide the load in proportion to their relative capacities—a nice problem with generators of such varied sizes and types.

The boiler house contains a battery of ten Babcock & Wilcox water tube boilers with a maximum capacity of 5,000 h. p. with the condensing engines here in use, and outside the building are two Green fuel economizers, one on either side of the stack, through which the feed water passes before entering the boilers. In case it is not desired to heat the water, however, the products of combustion may be led directly to the stack by the arrangement of the dampers.

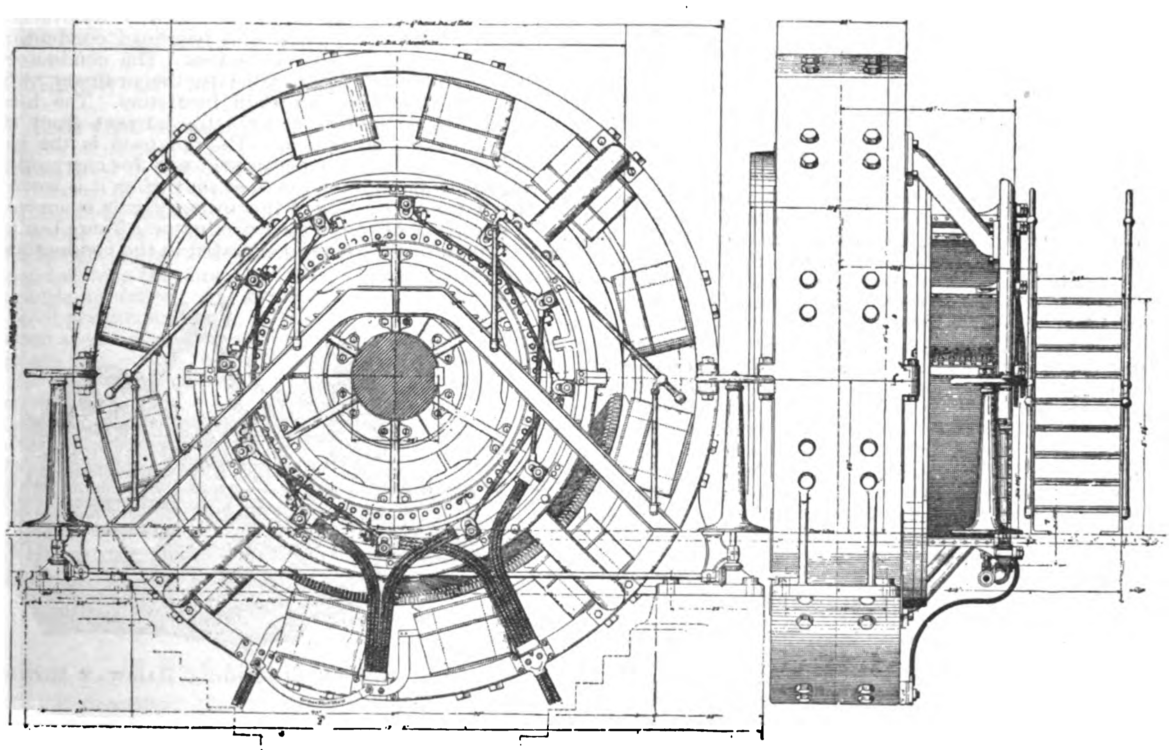
The condensers and boiler feed pumps are all in a pit at the south side of the engine room where they can be readily seen by visitors. There are two Allis vertical jet condensers and air pumps for the two Allis engines and a Conover jet condenser and air pump for the Williams engine; the Green engine is supplied with a duplex jet condenser made by the Worthington Co., and the McIntosh & Seymour engine with a single acting Deane jet condenser. There are also two boiler feed pumps; a Gould triplex and a Smith-Vaile, the latter arranged also for use in case of fire.

Water for condensing is taken from the lake by an 18 inch pipe inclined toward the power house. It is lifted vertically by the air pumps to a height of eight feet, condenses the steam and flows back to the lake through pipes inclined in that direction.

It will be remembered that oil is the only fuel allowed on the exposition grounds, with one or two small exceptions. The pumps and standpipes supplying this particular plant are placed at the right of the boilers; the former taking oil from the Exposition tanks through two-inch pipes, and the latter keeping it at a constant pressure of about five pounds to the square inch at the burners.

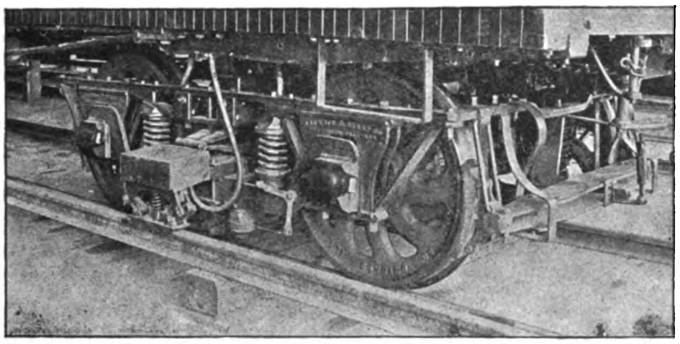
Steam from the boilers is led through 7-inch headers to the main 14-inch header extending the entire length of the building. From this three pipes run underneath the engine room floor to points conveniently near the engines, whence branches lead to engines, condensers and pumps. By this means the danger of a "shut down" in the event of trouble with any one pipe is avoided. The piping is all supported either from the ground or boilers on account of the light construction of the building; in fact the building is merely a shell to protect the machinery from the weather, and the two are almost entirely independent.

The contract for the construction of the railway, was awarded to the Western Dummy Railroad Company, but the road was



Assembly Drawing of the Great 1,500 K. W. Generator.

constructed and the entire electrical equipment furnished by the General Electric Company. The work was begun on August 3, 1892, and although much of it had to be done during the most severe winter known in many years, cars were in operation April 20, 1893. Heavy 12 x 12 pine supports carry heavy wooden traversers upon which are laid two longitudinal iron "I" beams for each track. The road is double tracked, and the service rails are spiked to cross ties laid upon the beams. Each line of rail is guarded by wooden stringers laid upon each side. Parallel to the service rails, between the two tracks, are four additional rails, similar in size and weight to those on which the trains travel.



THE CURRENT COLLECTOR.

They are raised about 12 inches above the level of the service rails upon creosoted blocks of wood, acting as insulators, and serve as conductors, taking the place of the usual overhead wires. The two rails nearest the two tracks carry the current for direct communication to the motors, the inmost pair serving as feeders. The feeder and each length of conductor rail are connected together by a well-soldered connection. The return circuit is completed by a careful bonding of each rail, and a connection to the iron longitudinal girders, which are also made part of the return.

The line consisting of 14,800 feet of double track and 1,900 feet of single track was not laid out until after the work of construction had been begun on nearly all the Fair buildings and many of them completed, and as it was desired that the structure be as unobtrusive as possible, the line is necessarily circuitous. Its Northern extremity is just north of the north end of the great Manufactures and Liberal Arts Building, where it passes in a loop over the north branch of the Lagoon, the station at this point giving access to both sides of the Lagoon and the Fisheries and Government buildings. Thence the road passes north through the group of foreign buildings, then east of the Art Palace, close to the State buildings, turns to the west, passing along the north side of the grounds. There are stations at the Fifty-seventh, Fifty-ninth and Sixty-second street entrances immediately over the gateways and also at points conveniently near most of the principal buildings. Trains run at 4-minute intervals, each train consisting of a motor car and three trailers, weighing 63 tons and seating 280 people. The weight of these trains, as compared with a train drawn in the usual way by a locomotive, shows a saving of about 20 tons dead weight. The cars are open, with doors in each side opening at the seats. By means of a lever at the end of the car, all the doors are opened or closed simultaneously.

The motor cars and trailers are each 46 feet long. The former are equipped with four "General Electric 2,000" motors of the single reduction four pole type, one on each axle. These are the most powerful railway motors yet constructed, and develop 133 h. p. each. They are geared for a speed of 30 miles an hour. The electricity is taken from the conductor rails by means of a sliding shoe contact. The motors are controlled by a series parallel controller of special type, operated by an ingenious compressed air mechanism and the motors are connected in a novel way. When the car is started the four motors are in series, then two in series and two short circuited, then the four in series of two pair of motors each in multiple, then two in multiple and two short circuited and finally all in multiple. By this method the trains are started smoothly and without jerk, and the speed is imperceptibly increased. Air is furnished to the controller and to the air brakes which are fitted to each train, by an air compressor pump, similar to that used on locomotives, but operated by an electric motor.

At night the cars and stations are beautifully illuminated by incandescent lights the current for which is taken from the conductor rail; and the road is fully protected by an electric block system.

The Intramural Railway, despite the short time allowed for its construction and equipment, is entirely successful from an electrical and a practical point of view, and fully bears out the expectations of the projectors and builders.

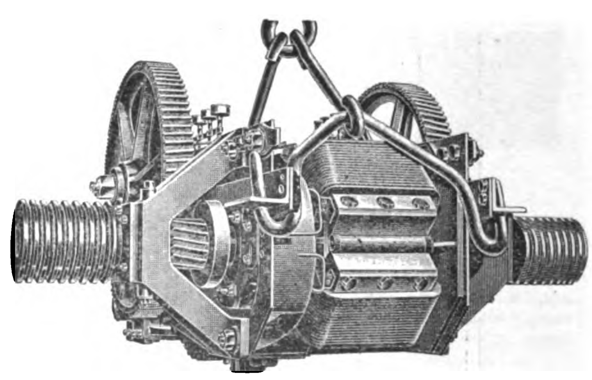
THE ELECTRIC RACK RAILWAY AT SALEVE, SWITZERLAND.[1]

THIS electric railway is arranged in three sections of about equal length, which meet at Monnetier Mairie. The first is to Etrembières, the second to Veyrier, and the third to Treize-Arbres. Each line is about two miles long. Though there is nothing wonderful in constructing such an electric railway, this particular line is remarkable because it is the first continental railway to be run entirely by electric power. The average gradient is one in 100, and the maximum one in 20.

The generating station is situated at Arthaz, where there is a water power plant driving Thury dynamos. The machines are specially designed for direct coupling and are run at very slow speeds. The turbines make forty-five revolutions per minute, and for some reason which we do not appreciate—probably because the designer had the common craving for direct coupling—the dynamos are also driven at this extraordinary low speed and are, therefore, very large in size in proportion to their output. Each dynamo gives 600 volts and 275 amperes, and is no less than 10 feet in diameter, the armature being 8 feet 6 inches; each dynamo weighs 19 tons. The shafts are vertical, and are coupled direct to the turbines, the field magnets being supported on special bed-plates. These are, perhaps, the largest direct current machines of this type yet made. At a reasonable speed they would give 1,650 kilowatts each, but at present they have the losses of 1,650 kilowatt machines, with only a tenth of their output owing to the low speed, and no counterbalancing advantages are evident.

The water power is taken from the Arve, which has 600 h. p. available as a minimum. The drop between the head and tail races is only 10 feet. The hydraulic work has been carried out by Messrs. Rieter & Co., of Winterthur. There are three turbines; one is used for the supply on week days, a second being added on Sundays and holidays when there is a heavy demand, and the third is a spare unit, which has not yet been put down. A small turbine in addition drives the exciter for the large generator magnets. It is expected that power will be available for supply to customers. Separate excitation is employed so that better regulation may be attempted than would be possible if the generators were self-excited. The exciter is driven at a constant speed, and as far as possible this is the case with the large machines, but the excitation of each of the large dynamos is controlled by an automatic governor, which is actuated by a relay on pilot wires.

The power is taken to the railway by overhead conductors carried by strong poles, and overhead conductors are used to carry the current to the motors. The conductor consists of a Vignole rail, running parallel to the ordinary rails, and carried by iron chairs on porcelain insulators. The locomotive, fitted with electric motors, collects the current from the rail by the usual trailing brush gear. The rail used is the same section as that employed in the permanent way for carrying the trains, but it is mounted upside down, so that when it is worn it can be used as an ordinary rail, and the ordinary rails when worn can be used in the place of the electric conductor. There is a total loss of 15 per cent. of the energy generated in the conductors themselves.



THURY ELECTRICAL RAILWAY MOTOR.

The carriages are of the composite type, with compartments at right angles to their length, and with platforms at the ends. Each carriage is capable of carrying 40 passengers; twenty-four in the three compartments and 16 on the two platforms, but only eight seats are provided. The carriage weighs fully 12 tons when loaded with a full complement of passengers.

The motor cars are provided with double sets of motor gear, driving pinions which gear into a rack after the method so common on the mountain railways in Switzerland and elsewhere. The motors are 4-pole Thury machines of 30 horse-power each, and run at 600 revolutions. The driver controls the cars from one of the platforms. He has not only the motors but eight

1. *Industries and Iron.*

brakes at hand, four of which are friction, two electric, and two dead stop brakes. The friction brakes close upon discs fixed on the motor axles. The electric brakes are the motors themselves, which can be run as generators when going down-hill, the power being taken up by resistance coils provided for the purpose. In addition there is the usual ratchet gear which prevents the train running backwards down-hill in case of an accident to the driving mechanism or a failure of the electric supply.

DISCUSSION OF PROF. JACKSON'S PAPER ON UNDERGROUND CABLE WORK.[1]

MR. M. D. LAW opened the discussion on Prof. Jackson's paper and spoke of underground trolley conduits. His experience with them made him believe them feasible now. MR. LOCKWOOD followed with remarks on underground telephone line construction, advocating the use of closed terra cotta blocks of cement-lined iron pipe. MR. ABBOTT spoke of the difficulty of withdrawing cables from conduits and told of a solid conduit built expressly to overcome this trouble.

MR. I. H. FARNHAM referred to underground work in Boston, the difficulties encountered from electrolysis due to the currents from trolley wires, and the remedy, *i. e.*, changing the polarity of the railway system to correspond with that of the cables. This stopped the action in some sections, while in others it was necessary to connect the positive side of the dynamo at the power house to the cables where the corrosive action was taking place, by means of a heavy copper wire. MR A. W. HEAVISIDE spoke of the necessity of having absolutely straight lines of conduit to facilitate the drawing in and out of the cables and hermetically sealed junction boxes to guard against gas and water. He then described the system in use at Newcastle, England. MR. DE CAMP a-ked some questions in regard to a number of points touched upon in the original paper, during the reading of which he was absent. MR. GEORGE W. BLODGETT told of certain difficulties experienced on telegraph lines in Maine. He also spoke of methods of drawing wires in and out of pipes. PROF. JACKSON then spoke again briefly in regard to points raised by the different speakers after which MR. LOCKWOOD closed the discussion and incidentally strongly condemned wooden conduits in particular and cheap construction in general.

DISCUSSION OF MR. PREECE'S PAPER.[2]

MR. T. D. LOCKWOOD opened the discussion. He described certain similar experiments made by Morse, Vail and Rogers on the Susquehanna River in which clear signals were received. The work of Mr. Deering of London in 1853 and of Mr. Lindsay of Dundee was also cited. He then spoke of the relations of trolley wires and telephone lines in this country and in England. He doubted the conclusiveness of Mr. Preece's experiments, that the communication between the shore and the island was due wholly to electromagnetic induction. He did not think that the system would ever be of great commercial value.

MR HEANICH spoke of an experiment made by him in which telephonic speech was clearly heard between the surface of the ground and the bottom of a colliery pit 60 fathoms deep, by means of parallel wires.

DR. C. E. EMERY told of telegraphing across streams during the war when lines were purposely cut to stop communication.

In answer to a question, Mr. Preece stated that the shore wire was put 20 feet from the ground. MR. PREECE promised to pursue the subject and present the results at the next Congress.

VARIOUS USES OF THE MULTI-CELLULAR ELECTROSTATIC VOLTMETER.[3]

BY DR. J. SAHULKA.

DR. SAHULKA described the electrostatic voltmeters and explained how he could measure the small charging current and the capacity of such a voltmeter, when inserted in an alternating current circuit. Electrostatic voltmeters can also be applied for several indirect measurements. The author used this voltmeter in particular to measure the capacity of condensers, which are inserted in an alternating current circuit. The capacity of condensers having a solid dielectric was found smaller, than when measured with a continuous current E. M. F. The energy losses were found to be in accordance with the law of Mr. Steinmetz.

1. THE ELECTRICAL ENGINEER, Vol. XVI., No. 278, p. 211.
2. Abstract of a Paper read before the International Electrical Congress, Aug. 21-25, 1893. See E. E. page 209.
3. Abstract of a Paper read before the International Electrical Congress, Chicago August 21-25, 1893.

LONDON ELECTRICAL ENGINEERING LABORATORIES.[1]

BY PROF. A. JAMIESON.

I.—*Advantages of college laboratories and workshops.* The teaching of engineering in its various subdivisions has been greatly improved of late by the addition of laboratory and workshop practice to the class room lectures and demonstrations. This is more especially evident with electrical engineering, for in this branch not only the most delicate apparatus, such as electrometers and galvanometers, but also all kinds of commercial instruments for measuring strong currents and high pressures, may be so fitted in a college laboratory as to enable students to obtain a thorough knowledge of their construction and action, together with the results derivable therefrom. In addition to instruction given by the aid of such physical appliances, it is possible to teach students how to turn, file, fit and solder metals, how to joint wires and cables for telegraph, telephone and electric light circuits, as well as how to test and manipulate the various instruments connected therewith. Further, when space and funds are available, steam engines and boilers, gas and oil engines, continuous and alternate current dynamos, accumulators, lamps, transformers and motors may be readily accommodated and so placed at the disposal of students that they can sketch, manipulate, investigate and report upon them. with a freedom such as no engineering works would tolerate or could afford to give to their apprentices. In a college laboratory it is also possible to give students a more thorough insight into the changes which electrical engineering appliances have undergone during the rise and progress of the science, than in a commercial workshop, as well as into the modifications desirable under different conditions and circumstances.

Of course a student must not depend entirely upon the laboratory and classroom for his complete training. *Otherwise he will lack the necessary knowledge of how to use materials, tools and men to the best pecuniary advantage.* He should endeavor to combine, supplement or prepare for his college education by an apprenticeship in a good mechanical or electrical engineering workshop. In any case this apprenticeship need not be so long or so arduous as it would otherwise be without a college training; more especially if his teachers are men who have themselves undergone a complete course of workshop instruction, and who are not only conversant with the latest developments of mechanical and electrical engineering, but who are in touch with installations and works so that they can take their students to the same, and thereby instruct them in their everyday working details.

There are many young men upon whom a complete *day class* college education would be thrown away. We must have "hewers of wood and drawers of water." These must of necessity go through the regular mill of five or six years continuous apprenticeship, picking up as best they can the various workshop details and the requisite skill of hand and eye to make a good workman. The more intelligent and ambitious will no doubt avail themselves of evening science classes, and may thus, in fact they often do, outstrip their more fortunate competitors. If a lad has the pecuniary means and if his heart is thoroughly bent upon rising to the higher positions of their trade or profession, and if he is at the same time endowed with a fair talent for mathematics and drawing, he will undoubtedly find that a combined day class college and workshop training pays best in the long run. Employers of labor, more especially in the United States of America, are now only too glad to avail themselves of cultured intelligence, *provided that it is combined with a willingness to do at once exactly as told, and the keeping of regular hours.* If such qualities are wanting in a college-trained youth, then the employer will naturally push on and give preference to the less-educated but more thoroughly broken-in workshop apprentice to the chagrin and disappointment of the former.

II.—*Should a college training precede, be combined with or follow an apprenticeship?* This is the vexed question which has been receiving unremitting attention in Great Britain ever since the introduction of technical schools and colleges. We still have in the old country many engineers who sneer at a college education, and who place little or no value on diplomas and degrees. They say that no one can become a thoroughly useful practical engineer unless he serves a complete apprenticeship in their shops, of at least *five* continuous years. Some of them even object to their apprentices attending evening classes, for fear that they will not start work by 6 a. m. Now we must not ignore or despise the opinions of such men, for they are in earnest, and they can (owing to their wealth, influence and numbers) seriously hamper the prosperity of a technical college. We should rather endeavor to induce them to try some of our more intelligent scholars. From thirteen years' experience I have found that if you can only plant a bright, intelligent, well-educated youth with an engineer of the aforesaid description, he will take his pennyworth out of him, and although he may be slow to acknowledge the error of his ways, he will be glad to see you back again with a similar application. I believe that in a short time employers of

1. Abstract of Paper read before the International Electrical Congress, August 21-25, 1893.

labor and professors will see, eye to eye, in this important question. My own opinion is that in the case of a youth whose parents are fairly well off, the lad should first receive a sound English education. If he is of a fidgety or conceited disposition, prone to change and to fiddling away his time in making toy models of steam engines or dynamos, he should begin with the works, so as to tame and lick him into shape. If, on the other hand, he is of a steady, thoughtful, observant temperament, possessing good mathematical abilities, he should commence with the college. The best plan of all is, however, to combine the two methods. In this respect we are perhaps more fortunate in Scotland than in almost any other part of the world, for our session is concentrated into winter months. We have thus the opportunity of testing the character of our students during the first session, and of advising them, their parents and their probable employers whether they should come back to us for the second and third year courses, or finish their apprenticeship right away before returning to the college. Such an arrangement works admirably, for should the student be of the right sort, he spends six months at the college and five months at the works each year for three years, finishing off with two years at the works, and at the higher evening classes, which are specially suited to the requirements of senior apprentices and draftsmen. To this happy combination of theory and practice, as well as to the porridge and milk of Scotland, I attribute the success of our students.

III.—*London Electrical Engineering Laboratories.*—It was my good fortune to spend about a fortnight this summer visiting the London Electrical Engineering Laboratories, with a view to improving my own one in Glasgow. In every instance I met with the greatest courtesy and kindness, which I may here add has also been notably the case when visiting the various works in this country. We form, I believe, one common engineering brotherhood, and whenever the request for information does not directly clash with our own individual interests, we are, as engineers and electricians, only too pleased to show the right hand of fellowship to a brother worker, and to extend to him any help that lies in our power.

Seeing that a combined college and workshop training need not occupy more time than a five years' apprenticeship of the old type, and considering the fact that employers of laborers are of necessity being gradually forced by competitive circumstances to employ technically educated assistants, it is not to be wondered at that in the metropolis (which is still the great centre of our electrical industries) there should have been started many electrical engineering laboratories and science classes. These laboratories are to be found in connection with institutions and colleges where the other collateral subjects forming a complete curriculum are also taught, so that a youth may receive as complete a scientific training as possible. Some of them are well endowed, and are therefore able to charge nominal fees, whilst others, having no endowments whatever, are under the necessity of charging what we in Scotland would deem very high rates for instruction. In all of them, however, there seems to be no lack of pupils. Each laboratory has a distinct character of its own, appealing to a certain class of students. Undoubtedly the best equipped electrical engineering laboratory in London or in Great Britain, for that matter, is that conducted by Prof. Ayrton, at the Central Institution of the City and Guilds of London for the advancement of technical education.

Next in importance, and appealing to the same class of students, viz.: those who are desirous of taking a prominent position in the electrical engineering world, is that of the "Sir William Siemens Laboratory," presented to King's College, London, by Lady Siemens in memory of her late husband. It is presided over by Prof. Dr. John Hopkinson, who has done as much as any one for the higher advancement of electrical engineering. It is divided into two portions, viz., the boiler, engine and dynamo testing room, situated in a vault next the Thames embankment, and the research laboratory at the uppermost Strand end of the College. Here there is only room for comparatively few students, but the apparatus is so good and new that any one will obtain an excellent training, more especially in that department of the science to which Dr. Hopkinson has devoted special attention, viz., the magnetic circuit of dynamos and transformers.

In the end of May and the beginning of June of this year several British engineering journals gave very complete illustrated descriptions of the new mechanical and electrical engineering laboratories which have just been erected and are now being equipped in University College, London, at a total cost of £20,000. The first engineering laboratory of any consequence in Great Britain was started by Prof. Kennedy in this college in 1878. It gave an impetus to all similar institutions, and seeing the progress has been so very rapid in this direction, it speaks well for the governors of their college that they have not rested content with what they had, but boldly appealed to the friends of the college and to the public for funds. They have specified for a set ot laboratories which they hope will be second to none in the country. Most certainly if Prof. Fleming can have his own way he will desire to instruct his students both by lectures and laboratory practice in all the latest and best ideas on alternate current generation, transmission and transformation, of which subjects he has made a special study, and written as well as lectured much to the great advantage of the electrical world at large. We now come to Finsbury Technical College, presided over by Prof. Silvanus P. Thompson. He takes immediate charge of the electrical department, which has five distinct laboratories. One of these is of special interest, as nowhere else did I find anything like it of the kind, in conception or extent. It is devoted entirely to the electro-deposition and electroplating of metals, which is a very large and remunerative business in London. Here are to be found vats for the deposition of gold, silver, nickel, copper, etc., with all the necessary appliances for producing the molds and for finishing off the deposited metals, as well as for testing the quality of the solutions. Some very pretty and original work has been done in this laboratory. I was glad to see that Prof. Thompson had secured the services of a thoroughly experienced electroplater to take charge of this department under him. In fact, what struck me most forcibly in connection with all the laboratories in London was this: that the assistants were men of experience, well paid for their services, and not merely green pupil teachers, depending upon a mere pittance and a certificate from their professor as a recompense for their work. Of course, such highly paid, skilled assistants can only be obtained in well-endowed institutions, such as under the City and Guilds of London, of which Finsbury College is one.

We must not forget to mention the Royal College of Science, South Kensington, or what is generally known as the Science and Art Department. The laboratory there is more of the nature of the Kelvin Laboratory at our Glasgow University, or the Andersonian Laboratory at our Technical College under Prof. Blyth, being devoted more to pure than to applied electricity, yet some very original, interesting and instructive researches have been carried out in it by Prof. Boys, which have been of great use to electrical engineers. The apparatus here is good of its kind, but the laboratory is by far too cramped. Rumor, however, has it that the British Government have secured an extensive site opposite the Imperial Institute, where they intend to erect physical and electrical laboratories worthy of the high position which they wish their college to attain, as the pattern of all such laboratories, under their supervision throughout the length and breadth of the United Kingdom and Ireland. At the Faraday House, Charing Cross Road, there is an institution of a diffierent kind from any we have mentioned. It is called "The Electrical Standardizing, Testing and Training Institution." The objects of this institution are very tersely set forth in their prospectus, and which may be obtained from the principal, Mr. Hugh Erat Harrison. The fees are £105 per annum. It is therefore suited to the sons of rich men, who may have a bent for electrical pursuits, or who may desire to succeed to a partnership after they have gained some electrical knowledge. It is backed by several engineering companies and men of position in the electrical world.

The School of Electrical Engineering and Submarine Telegraphy, situated at Hanover Square, London, has now been closed, and I understand that the kind of instruction which used to be given there, is now being continued by Mr. Tunzleman. This school supplied in its day many probationers to the great submarine telegraph companies, and latterly to electric lighting firms. There are also the People's Palace under Messrs. Slingo & Brooker, whose book on Electrical Engineering is no doubt well known to many of you, the Royal Indian College, Cooper's Hill, the Crystal Palace Company's School of Practical Engineering, the London College of Electrical Engineering, and the Polytechnic, Regent street. I must therefore refer those who are interested in this subject to a recent publication, termed: "Electrical Engineering as a Profession, and How to Enter it," by Mr. A. D. Southam, issued by Messrs. Whittaker & Co., Paternoster square, London, and 112 Fourth avenue, New York, where they will find an account of all the more prominent schools and colleges in Great Britain and America that give instruction in electrical engineering, as well as the names and terms of admission and apprenticeship of English firms. I would also refer you to Prof. Ayrton's inaugural address upon entering the presidentship of the English Institution of Electrical Engineers, last session, for his views on this subject. Had time permitted I should have liked to have said something about the examination question, and the value of diplomas and degrees. My own idea is that the examination should be so arranged and pitched as to prevent the possibility of cramming, and to exclude those students who merely wish to fiddle away their own and their master's time. As an instance of what I mean, I will conclude with stating one of the questions that I gave at the final examination in April last for the diploma in electrical engineering at the Glasgow and West of Scotland Technical College. "Go to the Faraday Works, Govan, and there make a complete set of freehand sketches of a ship lighting plant. From your sketches make a set of finished drawings. Take indicated horse-power cards, brake horse-power and electrical horse-power tests at the normal speed and power of the engine and dynamos. Find the mechanical efficiency of the engine, the electrical and commercial efficiency of the dynamo, and write a concise report upon the suitability of the plant for the work it will have to do. You can take five days to this question. You are

permitted to consult any book, but you must state the name of the book and the page whereon you got the information."

Discussion of Prof. Jamieson's paper.

PROF. LONGDON was very much pleased with the way in which Prof. Jamieson suggested the combination of apprenticeship with a college education so far as Scotland is concerned, but in America the conditions are somewhat different, at least in two respects. In the first place the college student is in school nine months or more of the year instead of six, and by the time he takes his one month holiday there is little time left to work in apprenticeship in the summer. Then in the second place, an apprenticeship in this country does not mean what it does in the older countries. It does not mean an education in any particular branch or trade. It means education with regard to the use of one machine. An employer will put a young man at work at a machine and the longer he stays at that machine and the better he knows how to use it, the less likely he is to get to work at any other machine.

DR. L. K. BOHM said that Prof. Jamieson put forward three great points. Shall the college education go alone or shall the college education go with an apprenticeship, or shall the apprenticeship go first. Now, with reference to this, men are trained for various works in life and consequently a course to be followed has to be selected for the special intended purpose. In the olden times in the German University, the student simply learned such things in natural science as the professor chose, and others were passed. There was not a regular system to it; but in modern times the thing has changed completely. We are going to different colleges in our days; they are conducted in very systematical ways, commencing with the easiest and ending with the most difficult parts of every branch of science. With reference to the various schools of England and the continent, the student has to be considered as well as the college. The boys, on the other side, generally enter college better prepared than on this side of the Atlantic, as far as his experience went. In most of the higher schools they are demanding a great deal more general education in all the branches of the sciences, so as to enable the student to digest what the professor is teaching.

PROF. CROSS.—I think the most of the Americans present are familiar with the Massachusetts Institute of Technology, with which I am so fortunate as to be connected, which is not remarkably different from any of the technological schools. Knowledge of our electrical engineering can be most readily attained by considering our exhibits in the Liberal Arts Building; they can give a far better idea of the work done in our school than I can do. There are three things which I will venture to say: In the first place, I am very glad to say that it was my experience from the beginning that the feeling of the employers in this country is not that which Prof. Jamieson has indicated is still to be found abroad. I have never met an engineer who acquired fame and fortune who did not rejoice with all his heart in the establishment of technical schools and the introduction of such courses in the colleges so that the young men might have these advantages. We have had no more earnest helpers in our technical schools than these advanced engineers, who have always been ready to take hold and help us, not only with their counsel and advice, but have come directly into the lecture rooms and given them a talk. I think we lack in this country schools for electrical artisans as distinguished from electrical engineers. I don't know of any school which has a course for electrical artisans. We have schools of training for other trades but not that. And, last, I want to do here what I have done in another place in print, to acknowledge most heartily the help which I personally received, and which the Institute received from the work and suggestions of Prof. Ayrton. It was due more to the papers of Prof. Ayrton than any other one thing that I was led to suggest a course of electrical engineering.

ON DIRECT-CURRENT OF VERY HIGH POTENTIAL.[1]

BY PROF. F. B. CROCKER.

THIS is in no sense a formal paper, being merely a note of some experimental results which I have obtained from two dynamos with very high potential, and it is well, I think, to define what I mean by that expression, which is in some doubt. By very high potential I mean from 5,000 to 11,000 volts. Machines of this character have received comparatively little attention, either from scientific experimenters or practical engineers. I have long believed that facts of theoretical and commercial importance might be derived from the investigation of such machines. Considering these machines historically, the first fact that meets our attention is that there exists a general and deeply-rooted idea that direct-current dynamos of very high potential are not at all practical. This unfavorable opinion is particularly strong in regard to the use of such machines for the transmission of power for any considerable distance; in fact, such a system is considered to be almost out of the question. It is in fact only with the object of bringing this system to notice that I am now speaking. The actual historical and practical facts are that the high potential direct current machines were more extensively and successfully operated when the dynamo first came into general use about 1880 than any other type, either direct or alternate. Furthermore, their number and size has largely increased and the voltage at which they can be practically worked has been steadily raised until we now have about 60-light arc dynamos of the standard size of large machines generating current at about 3,000 volts and 10 amperes. Arc dynamos of 90-light capacity are also regularly made by several manufacturers, and 120 or even 125-light machines are built and used. I happen to know of one station where there are four arc dynamos rated at 125 lights, which run every night with a load of from 100 to 105 lights. These machines must, of course, generate current at about 5,000 volts each. No great practical or other difficulty is found in operating arc machines, except that of danger to persons, but this is merely due to the high potential and does not depend very much upon the type of machine or character of current. Nevertheless, when it is suggested to use direct currents in the transmission of power, we are told that nothing over 1,000 or at the most 2,000 volts is at all practical. Why this discrepancy between the 5,000 volts which are practically used in arc lighting and 1,000 or 2,000 volts that are considered the limitation of such machines for power transmission? Perhaps the first answer to this question would be to say that the current is limited; that when you have 5,000 volts you cannot have more than 10 amperes, and if you want more amperes you must have less volts; consequently the number of watts. which, of course, is the entire question in power transmission, is limited. For example, the machines of 5,000 volts E. M. F. which I cited and which are in practical and successful use, generate only 10 amperes, and consequently have a capacity of 50 kilowatts, which is a small power, comparatively speaking, for power transmission, but is sufficient for ordinary arc lighting circuits. That, of course, is a fairly good explanation of why such machines are not applicable to power transmission, but is there any such limit as 10 amperes to the current? I myself always look with very much suspicion and doubt upon any such arbitrary limit as that. Experience has shown me that those arbitrary limits are usually imaginary. I would like to cite one simple case to show exactly what I mean. I can remember when, in connection with a design for motors, small motors, I desired to use drop forgings for the field magnet. I was told that the largest drop forging that could possibly be made was two pounds, and the best drop forger in this country would not undertake to make a larger drop forge than that. I now have no difficulty in getting drop forging up to 90 pounds. No such limit existed in that case and I doubt if any such limit exists in this case. I do not believe that nature decided that it would be impossible to generate currents of more than one absolute unit, and that it happens to be that of 10 amperes with a high potential direct current machine. Now, it is a fact, however, that should be added to this historical consideration of the subject, that numerous attempts have been made to employ such machines for power transmission and other purposes, and it cannot be said that those attempts have been successful; in fact. it can be said that they have been unsuccessful, but there again we have merely the negative of it. That same statement could have been applied to the steam engine for several hundred years, and it has only been true of the direct current machine for say ten years, consequently the case is by no means hopeless. Numerous attempts have been made by competent persons, involving the expenditure of many thousand dollars, and that is a fact that cannot be ignored and should receive proper consideration, but it by no means puts the use of direct current machines of very high potential over 5,000 volts or about that out of the question for power transmission or any other purpose.

Now, when we come to the actual construction of such machines, and that is really the only substantial point that I can bring before you, I have actual results, although I cannot say that there is any particular feature of such machines which is radical or which will insure their successful operation. The first point, of course, is insulation. That must be above suspicion. The ordinary limit of one megohm of insulation is simply nothing for such machines. One megohm of insulation resistance, with a voltage of 10,000, would give .01 of an ampere and 100 watts; consequently the machine insulation would be rapidly heated up and destroyed; therefore you must realize that a megohm, or even several megohms, is no insulation at all for such a machine. It should be at least 1,000 megohms. The next point is the commutator, because although the commutator might be considered the first point, as a matter of fact we must have the insulation before we can operate the machine at all, even for a few moments. The commutator, of course, must have a number of sections. It must have a considerable thickness of mica insulation between the bars, more than is ordinarily employed; I should say from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch between the bars. On the end of the commutator, where you get much more than the ordinary voltage between the bars, you require very much more thickness of mica insulation or some other insulation than is ordinarily given, because between those

1. Abstract of Address, Section C, International Electrical Congress, Aug. 24, 1893.

points the total difference of tension exists, and it is only necessary for the current to jump between these two points in order to produce a short spark. That is not the case, of course, between adjacent commutator bars. I should say that at that point there we should have an actual thickness of insulation of a quarter of an inch, and if possible the surface distance should be increased by having the insulation project.

The next point is the material for brushes, and I have found in that particular feature the most peculiar and important differences. In the first place, I consider that it is impossible to run an ordinary mica insulated commutator with copper brushes at that potential, the reason being that this film of copper which is worn off of the brushes by the mica is a sufficiently good conductor at that E. M. F. to carry many watts of current.

Now, I have found that in a high potential machine of only 5,000 volts, which I have experimented with, copper brushes could not be used for half a minute; that the copper was worked off on that mica and immediately produced a ring of fire all around the commutator. Naturally one would use carbon brushes in such a case, because the current is very small, comparatively speaking. I simply state the fact decidedly that you cannot use copper brushes for the reasons given. When you come to the carbon brushes, I have also found that the hardened carbon is better, for the reason that it does not produce a deposit or layer of carbon on the commutator to create the same effect which the copper does, but not to the same degree, because carbon is a much poorer conductor than copper. Therefore, carbon brushes, with a comparatively small area of contact and a fairly good pressure, not very great but sufficient to insure good contact, seems to give the proper working conditions.

Now, the machines I have actually constructed are two. One was a small machine of 1 h. p. capacity, and has a fluted armature. Some persons may think that is exactly wrong, but the results do not seem to show that it was. The fact that it was a fluted armature is one reason why I was successful with these machines. I will not say that positively. I simply say that it may be, because I think that heretofore machines of very high potential have not been made with fluted armature. It was of the ordinary Crocker-Wheeler type, and very perfectly insulated with mica and wound with double silk-covered wire. The potential of that machine was intended to be 5,000, and I have succeeded, by slightly raising the speed, in getting 5,500 volts out of it. It had only 32 commutator bars. I was told a good many years ago, that you could not have more than 19 volts to the bar. I could never understand why they gave 19 instead of 20, but such was the case. Now, this certainly shows that any such limit as that does not exist. That machine, is not, of course a practical machine, but it did run for hours at 5,000 volts; for an hour and a half at 5,500 volts. Now, that simply shows the minimum number of commutator bars that you can use, I should say. As to the current possible to get from that machine, of course that is small. As soon as you draw a current from a machine of that small number of commutator bars, there would be a tendency to stop the working, and that, of course, produces a ring of fire.

The next machine, which is much more practical, was of five horse-power capacity, and designed to generate 10,000 volts. It did generate 10,000 volts at a little below the calculated speed, strange to say, and gave 11,000 volts at about the speed it was designed for, which was 1,800 revolutions—not a high speed. This machine had 108 commutator bars, a much more practical number for such a voltage. The current of that machine was intended to be between .3 and .4 ampere, which gives about its capacity. It must be remembered that these machines did not give their full capacity, owing to the fact that the wire is extremely small and therefore the percentage of copper in the winding is small. The winding is largely made up of silk, consequently the capacity of the machine is reduced by that fact. That is inherent in any machine wound with extremely small wire.

It would be unfair to myself and to you to deny the fact that there is a spark when you approach the current capacity of the machine, and I think at the current capacity the spark would be too great. I have approached this 11,000 volt machine and I am a little bit afraid of it, to tell the exact truth, and I have not drawn the full capacity from it, but at about half its capacity it begins to spark, not badly, and a little above that it sparks a little more, and I should imagine it could not be run at its full nominal current capacity. The machine has only been recently finished, and since it was finished I have only had a few days to experiment with it, so I cannot give you full facts on it, as I did not want to rush it and break it down the first day. I might say that both machines broke down one or more times before I succeeded in getting them running, but that was simply due to inadvertence or accident. It was not inherent at all. There was some palpable error in their construction.

There is probably one point that strikes you as peculiar, and that is the very high internal resistance of such a machine. This machine has something like 1,500 ohms internal resistance. Now, as a matter of fact that is perfectly normal. The voltage is so high and the current is so small, that an armature resistance of 1,500 ohms is perfectly proper. In that connection I might argue that of course the proper or allowable armature resistance varies as the square of the E. M. F. with a given number of watts. Now, the preparation necessary in operating such a machine is to prevent the spark from starting. It is like the smoke nuisance. The way to get rid of the smoke is not to produce it. Now, that prevention of sparking in the first place is secured, as I say, largely by the use of hard carbon brushes, smooth hardened carbons, fine grained carbons. Another point, and that is, the tension of the frame must be kept half way between the terminal E. M. F. That is an important point. My friend, Mr. C. S. Bradley, who has also advocated the use of these machines for power transmission, has a system of this sort where he purposely and positively keeps the potential at the proper point half way between the terminal force. By that I mean, if the total E. M. F. is 10,000 volts between the two brushes, that the frame should have 5,000 volts potential between it and the positive brush, and the same way with the negative. If the machine is highly insulated it takes care of itself. I have measured this machines when in proper working condition, and the potential of the frame will be almost exactly half way between the terminal potential, within two or three per cent., and that is quite remarkable. I may say that these measurements of the voltage were made by an electrostatic voltmeter of the Sir William Thomson pattern, made by White of Glasgow, and compared at the lower voltages with the Weston voltmeter. It seemed to be in perfect working condition and gave very satisfactory results. Nothing could be more convenient and satisfactory for the purpose, because an electrostatic voltmeter has the advantage of not carrying any current and producing no drop or trouble of that kind.

Now, as to the application of these machines, I would say that the purposes to which I have applied them have been ordinary experimental work. For example, one of these machines at 3,000 or 4,000 volts will run a Geissler tube very beautifully. It will produce any other of the so-called electrostatic effects, that is to say, effects produced by very high potential and small quantities.

Another purpose to which the machine is applicable is testing of insulation, and in fact, that is one purpose for which I made it. It is a very good way to test insulation. You will immediately ask, Why not use a high potential transformer, as being more convenient and not having a commutor? I answer that by saying that I do not think that is the same test. If the wire is exposed to a direct current strain, I do not think an alternating current test is proper. If a wire is subjected to a direct current strain, it should be subjected to a direct current test. If it is subjected to an alternating current strain, it should be subjected to an alternating current test. That is simply my idea. The other application is, of course, power transmission, and that will be discussed hereafter, and I would say that of course it is not necessary to have the total voltage generated by one machine. In any plant no one dynamo should constitute more than a comparatively small fraction of the total plant, and if you have five dynamos in a central station or power transmission station, there is no reason why they should not be connected in series as well as in parallel, and is you want five machines, as I think you do in order to guard against the trouble from breakdowns, five to ten machines, then you can easily connect them in series and subdivide the voltage just to that extent. Each machine can generate a few thousand volts, two to five, and you could get the total voltage by the proper series connections of several machines.

Discussion of Prof. Crocker's Address.

MR. KEITH controverted Prof. Crocker's statement that there had been no practical application of direct high potentials for power transmission, and confirmed his prognostication that such a thing can be done. In 1887 he constructed for the Pacific Power Company in San Francisco four dynamos having a capacity or an output of 40 horse-power or 30,000 watts. This was done at 2,000 volts and 15 amperes. The dynamos were wound in shunt purely. Practice has shown since that a slight compounding was necessary. These dynamos have been in constant use for the last six years commercially, serving power. In San Francisco the commercial uses of such motors have succeeded to the extent of putting four Brush arc dynamos into a series, so that the potential differences between the extremes reaches sometimes upwards of 5,000 volts. This system has been working practically and is supplying motors in San Francisco approximating 1,000 horse-power in capacity; in fact, to-day in San Francisco there are but a very few motors, five or six all told, that are run by any other system. He had installed at a mine in Washington a power transmission plant running up to 2,000 volts at times with 40 amperes, and it had met with no difficulties. He had also in another portion of California a power transmission running up to nearly 2,000 volts and 30 amperes, with no trouble at the commutator. All that seems to be necessary is to make the commutator in a proper way by looking after the insulation. The insulation has to be perfect. Commutators have been made, not with wide spaces between them, but with the ordinary spaces such as would be used in dynamos of lower potential, but the number of sectors have been increased. On the 2,000 volt, 15 amperes plant, the number of commutator sectors is 84; on another of 70 horse-power, 2,500 volts and 21½ amperes, the num-

ber of segments is 150, so that the difference of potential between any two segments does not exceed about 30 volts. He had in his pocket a certificate from a man who had charge of one of these dynamos having an output capacity of 70 horse-power, saying that it is the prettiest running commutator he ever saw.

A NOVEL METHOD OF TRANSFORMING ALTERNATING INTO CONTINUOUS CURRENTS.[1]

BY CH. POLLAK.

SEVERAL considerations have led me to the construction of an apparatus for directly transforming alternating into direct currents that requires little cost, little space and little attendance, and gives high economical results. I call this transformation *direct* in contradistinction to the well-known method of using a dynamotor consisting of an alternate current motor and a direct current generator on the same axis.

An ordinary commutator, held in motion synchronously with an alternating current generator, produces a pulsating current of the same direction, whose tension varies between zero and a certain maximum given by the generator; it will, therefore, not be able to drive direct current motors or produce electrolytical effects, To fulfill these purposes, the tension of the pulsating current is to remain above a certain minimum determined by the counter E. M. F. to be overcome in the performance of any electrical work. From this I have drawn the following principles for the construction of the commutator.

The typical commutator of this kind consists of two ranges of insulated strips alternately connected with the generator. The width of the insulation between the strips is in a definite proportion to the width of the strips, which proportion is made adjustable so that the brushes of the commutator will take off only that part of the current whose tension has the proper value. If now, for instance, an accumulator battery is to be charged, I first adjust the proportion between the width of the strips and of their intervals in such a way that the tension of the pulsating current to be taken off by the brushes and led to the battery may not drop beneath the amount of the counter-E. M. F. of the accumulators, and the latter be avoided from discharging in the generator circuit. I finish the adjustment of the commutator by a definite displacement of the brushes in order to produce the interruptions of the pulsatory current at those moments when its tension is equal to the counter-E. M. F. of the battery being charged and so do away entirely with sparking.

In my first apparatus for laboratory purposes the commutator fixed on the prolonged axis of a small synchronous alternating current motor consisted of two sliding rings insulated from each other and which the alternating current is led to by brushes, and two ranges of strips with converging edges alternately connected to the sliding rings. The brushes sliding on the surface of the strips can be displaced in the ordinary way round the axis and parallel to it. The combination of these two movements allows me to fix the necessary minimum tension of the pulsatory current as well as the sparkless taking-off of this current at those moments when its tension is equal to the counter-E. M. F. and consequently its intensity zero.

Later on I left out the pointed strips in the apparatus for practical use. The edges of the strips are made parallel to the axis and the two ranges of strips fit to be displaced against each other by turning them separately round the axis; besides there are take-off brushes in double number whose distance can also be varied. By combining these two movements I may succeed without any difficulty in quickly attempting the appropriate position as to tension and sparkless working. To reduce the necessary attendance I shall provide the new machines with automatic brush regulators, The first apparatus was built for 30 amperes and has proved to perform the transformation with nearly no loss at all. The alternating current was passed through a step-down transformer and the secondary first through a liquid resistance and then through the commutator and battery to be charged. In both cases the number of watts in the primary and secondary circuit of the transformer were measured by means of a wattmeter. The output in the first case was 82,770; in the second 82,670. The motor having only to overcome the friction of the brushes requires only from 80 to 100 watts with full load.

Discussion of Dr. Pollak's Paper.

MR. FREKE made a few remarks on Dr. Pollak's Paper, pointing out the great advantages possessed by the machine there described. He spoke of accumulator central station work in Germany and stated that the transformers thus far used have cost something like $146,000, whereas, if they were taken out and Mr. Pollack's device used instead the cost would be only about that of the ordinary alternating current system. This question, he said, would soon be one of great importance in America also.

1. Abstract of a Paper read before the International Electrical Congress, Chicago, Aug. 21-25, 1893.

IRON FOR TRANSFORMERS.[1]

BY PROF. J. A. EWING, F. R. S.

IN selecting iron for use in the core of a transformer the first consideration is smallness of hysteresis losses; high permeability is comparatively a secondary desideratum. These two good qualities do not necessarily go together; the curve of the B-H cycle may have a relatively easy slope, and yet enclose a relatively small area. In actual tests the author has noticed that the order of merit in a set of samples is not always the same if permeability be made the criterion as it is if smallness of hysteresis losses be the criterion.

Notwithstanding the obvious and well recognized importance of small hysteresis losses in transformer iron, the metal that is actually used is of a very poor quality in this respect. The author has been much struck by this in the course of a recent experimental inquiry in which ten or a dozen specimens of iron were examined, most of which were supplied either as transformer iron or as specially pure metal prepared for the purpose of the experiment. In only one case were the hysteresis losses as low as they had been found to be in some wire which the author tested in 1881, in the laboratory in the University of Tokyo, and in most cases the losses were much greater.

The following figures may be taken as representative. They give the value of $\smile$ H d I, or the hysteresis loss incurred in a complete cycle of magnetic reversal, for various values of the magnetic induction B which is reversed. Column 1 states the results of one of the old Japanese tests. Column 2 refers to good sheet iron, and column 3 refers to another specimen of transformer metal, where it will seen that the losses are about half as great again as in the other. Column 4, where the losses are much greater still relates to a test of some wire which was furnished as a specimen of particularly fine Swedish charcoal iron.

TABLE OF HYSTERESIS LOSSES.

B	Values of $\smile$ H d I.			
	1	2	3	4
2,000	400	420	600	1,100
3,000	780	800	1,150	2,150
4,000	1,200	1,260	1,780	3,300
5,000	1,680	1,770	2,640	4,700
6,000	2,200	2,370	3,360	6,200
7,000	2,800	3,150	4,300	7,800
8,000	3,430	3,940	5,300	9,500
9,000	4,160	4,800	6,380	11,400
10,000	4,920	5,730	7,520	13,400
11,000	5,800	6,800	8,750	15,600
12,000	6,700	8,000	10,070	....

Chemical analysis is apparently an imperfect guide in the estimation of magnetic quality. Puddled iron, for instance, liberally streaked with slag, may seem on analysis less pure than specimens of ingot metal which have much higher hysteresis losses. Manganese, so essential to the strength and toughness of ingot iron, is well known to be deleterious magnetically. The form and general design of transformers has received all possible attention at the hands of engineers, but of the material which mainly determines their efficiency we apparently know very little. The author brings these remarks before the Congress in the hope that some suggestions may be made which will lead to a better understanding between electricians and iron makers of the conditions which govern the production of magnetically soft iron.

ON A METHOD OF GOVERNING AN ELECTRIC MOTOR FOR CHRONOGRAPHIC PURPOSES.[2]

BY DR. A. G. WEBSTER.

IN the course of some experiments last winter when it was necessary to measure intervals of time of the order of a thousandth of second with an accuracy of one part in ten thousand if possible, so that an interval of a ten millionth of a second must be distinguishable, and high velocities were necessary, clockwork was out of the question, and I determined to try the motor, and to attempt to give it a positive governor. Upon the shaft of a small motor carrying a drum and disc for registration was directly

1. Abstract of a Paper read before the International Electrical Congress, Chicago, Aug. 21-25, 1893.

2. Abstract of a Paper read before the International Electrical Congress, Chicago Aug. 21-25, 1893.

attached the armature of a smaller motor arranged as an alternator, with separately excited field magnets. The current for the armature of the latter was made alternating by a commutator arrangement, composed of mercury cups and wires carried by the prongs of an electrically maintained tuning fork. The direct current motor was now run up to synchronism, in hopes that the alternator would fall into step with the tuning fork and be automatically governed. As it is obviously out of the question to pass more than a very small current through a mercury brake, the question of phase is equally important with that of synchronism, and it was at first found impossible to make the governor work at all. It was soon found that an alternating current was not necessary, but that an intermittent current would serve as well, so one of the reversed currents was left out, and the complicated commutator on the tuning fork was reduced to a simple break.

In order to throw on the governing current at the right phase, a mirror was placed upon the end of a shaft with its normal slightly inclined to the direction of the axis, so that a point of light would be seen as a continuous circle. A glow lamp reflected in a mirror carried by the governing tuning-fork with an interposed slit, was looked at in this mirror, and instead of a continuous circle of light, there were then seen a number of bright arcs, which diminished as the speed of the motor was brought up to synchronism. When the number of arcs is reduced to two, synchronism is attained, if the arc stands still; in practice, however, by means of a fluid rheostat in the circuit of the field magnets of the driving motor the speed is made gradually to vary, so that the arcs revolve slowly, and when a part of the revolution is reached that a few trials show to denote the proper phase, the governing current is thrown on, and the apparatus runs controlled, and the arcs of light stand perfectly still. In order to give instant notice of a failure of the governor, a telephone was placed across the terminals of the armature, which spoke up in stentorian tones of beats on the least divergence from synchronism, so that the observer would be recalled even from the farthest part of the next room. An amperemeter also showed by the presence or absence of oscillations corresponding to the beats when the governor was acting properly. The motor which I used for driving was capable of giving out one-third of a horse power, and the number of revolutions was 32 per second. The tuning-fork was a large electromagnetic fork by König, carrying a steel mirror, and a sliding weight.

SOME MEASUREMENTS OF THE TEMPERATURE VARIATION IN THE ELECTRICAL RESISTANCE OF A SAMPLE OF COPPER.[1]

BY A. E. KENNELLY AND R. A. FESSENDEN.

In view of the discrepancies existing between the best known measurements of the temperature coefficient of copper, by Arndtsen, Cailletet & Bouty, giving results practically represented by straight lines, Siemens' results with the line bending distinctly downwards, and Matthiessen's results with the line bending as distinctly upwards, the writers of this paper made a number of measurements in the spring of 1890 upon a sample of copper wire. These measurements were made with great care and repeated until similar results were obtained in successive series. The wire tested was sealed within the bulb of an air thermometer, so that there could be no appreciable variation between the temperature of the wire itself and the temperature indicated by the pressure of the air in the bulb it occupied. The final results, after full corrections for expansion of the bulb, etc., indicate a linear relation between the resistance and temperature of the wire between the limits of 20° C. and 250° C., indicating a uniform temperature coefficient of 0.406 per cent. per degree cent. throughout that range, the maximum observed being 0.4097 per cent. and the minimum 0.399 per cent. at any point. The details of these measurements and the description of the apparatus are submitted in the form of an appendix.

In a "Note on the Temperature of Lowest Visible Red Heat," the authors describe a few measurements that were made of the resistance of copper wires enclosed in exhausted glass tubes and gradually raised to just visible red heat by gradually increasing the current strength through them. Reckoning back with the linear temperature coefficient of 0.00406 from the normal temperature to zero centigrade, the resistance of the wire was found to be three times that zero when visible luminosity was just attained, the mean calculated ratio being in fact 3.001. If the same linear temperature coefficient be assumed throughout that whole range, the corresponding temperature of lowest visible luminosity becomes 493° C. in this instance.

In the discussion that followed, the author, in reply to a question by the chairman, stated that the color noted at the beginning of incandescence was red. Mr. Preece pointed out that at Cambridge the various discrepancies as to the specific resistance of copper are attributed to a difference in density. Matthiessen, he said, used copper of a density of 8.9, while that of the Cambridge experiments was 8.946, and the difference in specific resistance was found to form a direct ratio between these numbers. He complimented Mr. Kennelly highly on his work and said that the result of his paper would be to compel English electricians to accept his coefficient without the slightest hesitation.

1. Abstract of a Paper read before the International Electrical Congress, Chicago, August 21-25, 1893.

AN IMPROVED FORM OF INSTRUMENT FOR THE MEASUREMENT OF MAGNETIC RELUCTANCE.[1]

BY A. E. KENNELLY.

The author, after a few preliminary remarks, described an instrument for the measurement of magnetic permeance or reluctance of iron in which the reluctance of a sample bar is compared with that of standard bars of soft Norway iron and showed by figures the well-known galvanic arrangement of circuits in which two resistances can be compared by the null method, the corresponding condition of the magnetic circuits, and the actual instrument. The last consists of a disc armature, wound with 100 radial wires from centre to circumference, half of which is always covered by the pole-pieces above and below it. A unifilar suspension supplies a current of about 10 milliamperes to this disc. A sensibly-constant tension upon the suspension is obtained by means of a spiral spring within the lower slide tube.

The *modus operandi* is as follows:

A sample strip or flat bar of the iron to be tested is laid across a gap provided for the purpose. The breadth of the bar is conveniently 1 inch (2.54 cms.) and the height ½ inch (1.27 cm.) Strips of soft iron to match this are laid across another gap in parallel, each being say 1 x ⅛ inch (2.54 X. O. 318 cm.) If the disc circuit is then closed, and if there is no appreciable residual magnetism in the apparatus, the disc will remain uninfluenced and its index at zero. The field magnets are now excited in series with a suitable and measured current. The disc and pointer will then move to one side or the other about the axis of suspension according to the preponderance of reluctance between the two sides, and soft iron strips have to be added or removed across the second gap until balance is restored.

The instrument may also be used to indicate the retentiveness of hard iron and steel, and in addition, has the advantage of absence of hysteresis in the moving and indicating parts, which contain no iron, great sensitiveness and control and small reluctance in the narrow air-gap or path of differential magnetization.

EXPLANATION OF THE FERRANTI PHENOMENON.[1]

BY DR. J. SAHULKA.

Dr. Sahulka described the Ferranti phenomenon that was first observed in the Deptford central station, near London, when the primary of a step-up converter was connected with an alternating current generator, whilst the secondary was connected with a Ferranti concentric cable. In this case the ratio of transformation may be considerably increased. Mr. Sahulka proved that the cause of the Ferranti phenomenon is due to the magnetic leakage in the transformer, and the fact was also experimentally proved by him.

A MAINE STREET RAILWAY ASSOCIATION.

On August 16 representatives of all the electric and horse railroads in Maine met at the Portland Railroad Company's office in Portland. These roads were represented by their officers: Portland Railroad—W. R. Wood, president. Waterville and Fairfield, A. F. Gerald, general manager. Bath—A. F. Gerald, general manager. Biddeford and Saco—E. N. Banks, president. Mousam River—E. K. Day, superintendent. Rockland, Thomaston and Camden—G. B. Macomber, president. Augusta, Hallowell and Gardiner—G. E. Macomber, treasurer. Fryeburg—S. W. Fife, general manager. Lewiston and Auburn—F. W. Dana, president.

They formed an association to promote the prosperity of all the roads. The time of the annual meeting is set for the first Wednesday in February. A constitution and by-laws were adopted. These officers were elected:

President—W. R. Wood, Portland. Secretary and Treasurer—E. A. Newman, Portland. Directors—W. R. Wood, Portland; F. H. Twitchell, Bath; A. F. Gerald, Waterville; J. M. Haynes, Augusta; G. E. Macomber, Rockland; E. H. Banks, Biddeford; E. K. Day, Sandford; S. W. Fife, Fryeburg; F. N. Laughton, Bangor; F. W. Dana, Lewiston. Executive Committee—W. R. Wood, G. E. Macomber, A. F. Gerald, F. N. Laughton, F. W. Dana.

After the meeting the party took a steamer for the Ottawa House, where a special dinner was served, and then the visitors took the afternoon trains for home.

1. Abstract of a Paper read before the International Electrical Congress, Chicago, August 21-25, 1893.

1. Abstract of a Paper read before the International Electrical Congress, Chicago, August 21-25, 1893.

LITERATURE.

A Manual of Telephony. By W. H. Preece and Arthur J. Stubbs. *London and New York*, Whittaker & Co., 1893. Pp. XVIII., 508, Illustrated. 5 by 7½ inches. Price 15 shillings.

OUR criticism of Preece and Maier's "The Telephone," upon its appearance some years ago, has been justified by the abandonment of that work and the issue of a new one in its place, by a different hand. The improvement, we are glad to say, is very marked.

The book is devoted mainly to instruments, the treatment of lines and cables being avowedly brief and cursory, and, so far as it goes, hardly so satisfactory as in the recent work of Prof. Hopkins on "Telephone Lines."

The best section is, perhaps, that on multiple switchboards, which presents the subject clearly, and is brought down to date by the inclusion of the latest development — the "branch terminal" multiple.

The space devoted to the special apparatus of the British Post Office, is less disproportionate than in the former book, but seems to us still rather greater than is warranted by the general interest in those complicated devices to avoid the simple magneto call system. Since the German Imperial Telegraph Administration, yielding to the inevitable logic of facts, has begun to apply the magnets, the telephone service of the British Post Office is probably the only one of any importance in the world which still clings to the antiquated battery call bell.

The peculiar feature of the post office system is the maintenance of a permanent battery current on the line—a feature which gives rise to endless complication, especially in trunk and toll line service, for the connections must be so made that the various line batteries reinforce each other, and the current must suffice to hold all the galvanometer needles in a certain position.

The P. O. multiple switchboard looks especially clumsy, with its polarized relays, lever switches, and quadruple plugs and cords, after which the reader is informed that for trunk and toll lines "the arrangements are slightly more-complex." It seems to us that with reasonably compact switchboards, the limited number of subscribers in the government exchanges would scarcely require the multiple system.

We must take exception to the statement (p. 194) that in exchanges of over 100 subscribers less than 100 must necessarily be apportioned to an operator. The number of subscribers allowed per operator depends, of course, on the number of calls, the amount of trunking, and other features of the particular exchange, and in single office exchanges, up to about 1,000 subscribers, it is not unusual to find each operator handling 100 subscribers on standard switchboards. The work is facilitated by the operator being enabled to plug direct into the two adjunct switchboards on each side, making 500 subscribers within plugging distance, instead of 200, as stated (p. 206). There are also much better connecting systems in use than that described (p. 207). which is rather clumsy.

The statement (p. 200) about single cord switchboards is misleading. Single cord switchboards of all kinds have now been abandoned in America, and outside of England we believe they have never prevailed anywhere except with the multiple system, and even the single cord multiple is now out of favor, being retained only for trunk or toll lines.

The treatment of lightning arresters (pp. 115–119) is very brief, while batteries (p. 120) are dismissed with but a mention. English telephone engineers are still free from electric railway and other strong current troubles, but we fear the era of such vexations is approaching for them also, and must be anticipated with remedies in advance.

The attention given to magneto and vibrating bells, respectively, is in inverse ratio to their relative importance.

The form of Edison transmitter illustrated (p. 32) is, by the way, not the one which went into actual use.

We cannot sympathize with the changes in the names of some common things. "Switch hole" and "switch spring" are scarcely more elegant English than the generally accepted and expressive "spring jack." "Peg" would doubtless serve as well as "plug," but the latter is in common use and we see no gain in the change. "Renter" sounds like a downright barbarism, and the reader will appreciate the information kindly vouchsafed that such is the official name for the much-abused and long-suffering "subscriber," who might, perhaps, be called a "render" because he sometimes tears his hair and his clothes when excited.

Our most general criticism applies as well to all other existing treatises on the telephone, viz., that the book is devoted mostly to describing particular types of instruments, instead of the discussion of general principles and the formulation of valuable rules of practice, such as we might hope to receive from the distinguished technical authority of the British Telegraphs now in this country. We see no advantage in rehearsing in every book on the telephone the descriptions of all the known forms of receivers and transmitters. The telephone engineer may occasionally wish to refer to these descriptions, but he surely does not need them repeated in every book in his library.

The difficulty of producing on this plan a book that shall be "up to date" even at the time of issue, is shown by the telephone given as the standard receiver of the Bavarian Telegraph Administration (p. 50), the fact being that the single-pole model described has been superseded by a double-pole Bell telephone very similar to that used elsewhere. The instrument lightning arrester shown as the standard of the German Imperial Telegraphs has also given place to a different form.

Types change so rapidly, in fact, that a book representing fairly well the practice of to-day quickly loses its actuality. It seems to us therefore that a really satisfactory manual of telephony should give us a thorough discussion of principles and some general rules of practice instead of mere descriptions of types of instruments. In its sphere, however, this is a good and conscientious piece of work and will be of service to the American telephone engineer as reflecting the state of the art in Europe, although we cannot help thinking that it would have found a wider market if the price had been reduced instead of being raised.

It is interesting to note that a complete toll line system for the whole of Great Britain is now under construction, with a central toll line exchange at Leeds for the entire country. There is no reason why the numerous large and busy cities lying close together in Great Britain should not all be bound together into a single telephone such as has already been nearly completed in Switzerland with the most favorable results.

The English telephone exchanges belong to the National Telephone Company, while the toll lines are being constructed by the Post Office. We wonder how the battery calls and the permanent line batteries of the latter are to be harmonized with the magnet system of the company—by being eliminated, let us hope. In any case the service must be otherwise ordered than on the telephone cable recently laid by the Post Office between Glasgow and Belfast, where no facilities are given exchange subscribers, but the public is invited to betake itself to the telegraph office in each town. The natural result is that no two men will take the trouble to make an appointment and engage the line beforehand and discommode themselves by going to a particular place at each end, where they would pay the price of nearly a dozen sixpenny telegrams for a three minutes' conversation. The cable therefore lies in the sea unused, a glaring instance of the neglect of commercial conditions. We do not try to talk thus between New York and Boston, Buffalo, Washington or Chicago. A man talks with his distant correspondent from his own office set, it might almost be said from his own desk, and that is the way to do it. That is the way we shall talk to London when Silvanus Thompson induces Alexander Siemens to build that new cable for him.

Recent Researches In Electricity and Magnetism. By J. J. Thomson, M. A., F. R. S., D. Sc. *Oxford.* The Clarendon Press. *New York*, Macmillan & Co. Cloth. Illus. 578 pages. Price, $4.50.

PROF. THOMSON states that this magnificient volume is intended as a sequel to Clerk Maxwell's classic Treatise. While it gives the furthest reach of recent research it goes back to that source of the great principles of the science. Adopting the Maxwellian theory, Prof. Thomson disdains to consider any other, and he has assumed throughout, the equations of the electromagnetic field given by Maxwell in the ninth chapter of the second volume of his treatise.

The presentation of the subject of the electric field in Chapter I. is geometrical and physical, rather than analytical, and starts out with the conception introduced by Faraday of tubes of electric force, or, rather, of electrostatic induction. This chapter is most interesting, especially that section of it which relates to the electromagnetic theory of light. Prof. Thomson concludes it by saying: "Taking these tubes for granted, they afford a convenient means of getting a vivid picture of the processes occurring in the electromagnetic field, and are especially suitable for expressing the relations which exist between chemical change and electrical action."

Chapter II. discusses the passage of electricity through gases and is in reality intended to be a close summary of the work of any value in this line of investigation. Very little has, in fact, been overlooked, except some of the later developments on this side of the water, and in the absence of anything else even half as well done, this chapter is most welcome.

Chapter III. on "Conjugate Functions" embodies an account of the application of Schwarz's method of transformation to the solution of two-dimensional problems in electrostatics. From this we proceed to Chapter IV. on "Electrical Waves and Oscillations," where one's interest and sympathies are immediately aroused. This chapter is devoted to an investigation of the theory of alternating currents flowing in cylindrical or spherical conductors, and occupies no fewer than 130 pages. Then comes, in Chapter V., a description and review of Hertz's experiments on electromagnetic waves, together with some investigations on the electromagnetic theory of light; particularly the scattering of light by

small metallic particles; on reflection from metals; and on the rotation of the plane of polarization by reflection from a magnet. Chapter VI. considers the distribution of rapidly alternating currents, and follows chiefly the lines of Lord Rayleigh's work on the laws according to which such currents distribute themselves throughout a network of conductors. Chapter VII., and last, on "Electromotive Intensity in Moving Bodies," discusses the equations which hold when a dielectric is moving in a magnetic field; as well as some problems connected with the distribution of currents in rotating conductors. There is also an appendix on some of Prof. Thomson's experiments as to the electrolysis of steam, employing modified Perrot apparatus.

The index is most helpful where such a large amount of experimentation has been noted. Curiously enough, we find in this index Matteuci's name with an extra "h," and Elihu Thomson's with a superfluous "p." But these and a few other things are such trivial blemishes on a splendid performance, we feel like apologizing for the mention of them. The book is a worthy sequel to that of Maxwell, and Prof. Thomson places himself with it on an elevation surely not far below that of his great exemplar.

Electricity Up To Date. By John B. Verity. *London and New York.* F. Warne & Co. Paper. Illustrated. 163 pages. Price 75 cents.

THIS little book couched in popoular phraseology appears to have met a want, as the present edition is the second. It is cleverly done, and is worthy of its title in covering all the latest applications. We are sorry to note that the author speaks approvingly of electrocution. In view of the fact that he has dropped the chapter on "electric cooking" from this edition, the subject of electrocution, which is one form of that branch of the art, should not have been referred to. As it is, we wish to point out that the latest case of gerrycide in this country was a ghastly pitched battle of several hours' duration between electricity and life, the latter winning, and the criminal being done to death ultimately with the help of unlimited doses of narcotics.

We are glad to see some sensible observations on trolley railroads. Mr. Verity is one of the progressive Englishmen who do not look upon their country as the pink of beauty and scenic perfection, or talk as though a few trim poles and wires would desecrate the majesty of the king's highway. Electric cars would be a great relief to the frightful ugliness and dense somnolence of some English market towns, and such men as Mr. Verity might do worse than advocate electricity as their forefathers did steam, against equally stupid prejudice.

Arithmetic of Magnetism and Electricity. By John T. Morrow and Thorburn Reid. *Lynn, Mass.* Bubier Publishing Co. Cloth. 145 pages. Price, $1.

A very useful and compact little book giving a series of rules and examples applied to circuits and apparatus. The general laws of circuits are first taken up, then comes a chapter on batteries, followed by a section on magnetism, to which succeeds the treatment of direct and alternating apparatus. The arithmetic of lighting, power and railway work is also gone into very simply and clearly, without waste of words. The book is neatly got up, and should be well received in the humbler walks of electricity.

FEWER BELL TELEPHONES NEEDED IN BAD TIMES.

THE BELL TELEPHONE COMPANY shows the effect of the hard times in its instrument statement for the month ended August 20. The shipments were 4,161 instruments, a decrease of 3,155 compared with last year, and the returns were 6,596, an increase of 790, thus showing that there were 2,435 more instruments taken out than were rented. August is always a poor month. The comparative statement for the month and eight months follows:

Month Aug. 4.	1893.	1892.	Decrease.
Shipments	4,161	7,316	3,155
Returned	6,599	5,806	*790
Net output	†2,435	1,510	3,945
Since Dec. 20.	1892–93.	1891–92.	
Shipments	63,627	65,219	1,592
Returned	39,348	34,482	*4,866
Net output	24,279	30,737	6,458
Instruments in use Aug. 20.	576,999	540,144	36,855

* Increase. † Deficit.

THE SHORT GEARLESS MOTOR.

MR. E. H. MORRISON has issued in connection with the Short electric railway exhibit at the World's Fair a very neat little folder describing the exhibit in Electricity Building, and giving some details as to the remarkably good work done with gearless motors.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUGUST 15, 1893.

Alarms and Signals:—

Fire Alarm and Individual Electric Call, J. Young, Chicago, Ill., 503,187. Filed July 18, 1884.

An automatic circuit closing dial with call bells for use in connection with the annunciator call systems already in service.

Fire Alarm Box, J. G. Kraetz, Buffalo, N. Y., 503,376. Filed June 3, 1893.

Conductors, Conduits and Insulators:—

Conductor Support and Insulator, D. T. Bennett, Trenton, N. J., 503,519. Filed May 15, 1893.

A form of trolley wire hanger adapted to be used either overhead or underground.

Insulator, L. McCarthy, Boston, Mass., 503,549. Filed Jan. 14, 1893.

Dynamos and Motors:—

Alternating Current Electric Motor, F. A. Wessels, Boston, Mass., 503,183. Filed April 3, 1888.

Has for its object to obtain in the armature and field of the machine respectively alternations of current of the proper relative phase, the machine being energized as to both its parts from the same alternating current wires directly or indirectly.

Electrical Reciprocating Motor, H. S. McKay, Boston, Mass., 503,213. Filed May 13, 1892.

The invention consists especially in the means for making and commutating the circuit and in a pneumatic speed regulator for the armature and connecting parts.

Method of Winding Coils for Dynamo Electric Armatures, E. Thomson, Swampscott, Mass., 503,445. Filed April 19, 1893.

The invention consists in winding a coil on a form in a trapezoidal shape, then removing it from the form and bending the trapezoid into two incomplete rectangles with their common side missing.

Method of Winding Coils for Dynamo Electric Armatures, J. B. Blood, Lynn, Mass., 503,449. Filed April 19, 1893

The invention consists in winding the coil in a trapezoidal form, bringing its parallel sides together, bringing its ends to an approximate right angle with the parallel sides and then opening the coil to form two incomplete rectangles lying in different planes.

Regulator for Electric Motors, C. J. Davidson, Prince's Bay, N. Y., 503,453. Filed March 8, 1893.

Employs a resistance partly in series and partly in shunt with the armature, and a switch for varying the resistance.

Galvanic and Thermo-Electric Batteries:—

Battery Jar, A. M. Gee, Edgar, Neb., 503,182. Filed Feb. 18, 1893.

Has for its object to prevent the possibility of spilling the battery fluid when the battery is charged.

Galvanic Battery, C. H. Brown, Portland, Ore., 503,567. Filed May 3, 1893.

Employs a positive plate formed of an alloy of aluminum and zinc.

Lamps and Appurtenances:—

Stalactite for Electric Lamps, J. Dalzell, Findlay, O. Design, 22,712. Filed July 13, 1893.

Incandescent Lamp Socket, C. T. Lee, Boston, Mass., 503,349. Filed May 3, 1892.

A moulded socket provided between its mouth and the terminals with a ring of rubber projecting into the cavity and forming a waterproof joint.

Electric Arc Lamp, L. E. Howard, Plainfield, N. J., 503,538. Filed Dec. 20, 1892.

Employs a chamber with transparent walls enclosing the portions of the positive and negative electrodes between which the arc is formed.

Electric Arc Lamp, L. E. Howard, Plainfield, N. J., 503,539. Filed June 9, 1893.

Similar in its object to No. 503,538.

Miscellaneous:—

Connector, H. L. Webb, New York, N. Y., 503,181. Filed Feb. 28, 1891.

A coupling consisting of a metal sleeve in which are placed the free ends of the wires or strips to be connected. These ends are corrugated and held against lateral displacement by the sleeve.

Electrical Condenser, A. Wurts, Pittsburgh, Pa., 503,186. Filed Oct. 5, 1892.

Claim 1 follows:

In a condenser a dielectric composed of a fibrous substance moist with oil.

Cleat, D. B. Bronson, Chicago, Ill., 503,193. Filed Feb. 14, 1893.

Method of and Apparatus for the Transmission of Electrical Energy, R. M. Hunter, Philadelphia, Pa., 503,321. Filed Nov. 21, 1892.

Employs a line circuit in which is directly connected a continuous current generator; an alternating current generator and a transformer having one of its coils in circuit with the line and the other in circuit with the alternating generator.

Composition of Matter for Coating with Silver, T. Z. H. St. Cyr, Thompsonville, Conn., 503,358. Filed Dec. 27, 1892.

Claim:

A solution for coating metals consisting of silver-cyanide, potassium-cyanide and water, the amount of metallic silver in the solution three one hundred and thirty-sixths to five one hundred and thirty-eighths of the total weight.

Cleat for Electric Wires, J. Pawolowski, Cincinnati, Ohio, 503,384. Filed Jan. 7, 1893.

Binding Post for Electrical Connections, A. Kohl, Centralia, Ill., 503,427. Filed March 24, 1893.

Process of Producing Chlorine and Purifying Lead, F. M. Lyte and C. H. M. Lyte, London, Eng., 503,429. Filed April 10, 1893.

Relates to the production of chlorine conjointly with the purification of lead and the recovery of silver therefrom.

Apparatus for Electrolysis of Fused Salts, W. E. Case, Auburn, N. Y., 503,451. Filed Jan. 17, 1891.

Railways and Appliances:—

Controlling Switch for Electrically Propelled Vehicles, H. P. Davis, Pittsburgh, Pa., 503,279. Filed Jan. 7, 1893.

Employs a circular series of studs, a body pivotted at the centre of the circuit and having half as many recesses as there are studs, bridging pieces fitting over the recesses on the periphery of said body, and springs forcing the bridging pieces outward.

Trolley Wire Finder, H. C. Jones, Montgomery, Ala., 503,421. Filed May 31, 1893.

The device consists of two spools supported on a frame carried by the trolley-pole and having helical threads with an inward pitch for automatically guiding the trolley wheel back upon the wire.

Trolley Wire Switch, E. A. Sperry, Chicago, Ill., 503,443. Filed April 1, 1892.
A switch for use in connection with trolley wire systems for mines designed especially to cut in or out sections of trolley wire, as required.

Electric Engine, W. Lawrence, New York, N. Y., 503,487. Filed Aug. 17, 1892.
The power is applied directly to the axles of the machine, with a reciprocating motion, from a magnet plate or armature, through suitable connecting rods.

Railway Signaling, I. A. Timmis, London, Eng., 503,505. Filed Oct. 13, 1892.
Relates to means for automatically operating electric railway signals.

Electric Trolley Wheel, J. W. Clark, Menands, N. Y., 503,562. Filed Feb. 23, 1893.
An ice cutting trolley wheel.

Electric Supply System for Railways, J. W. Bates, Minneapolis, Minn., 503,566. Filed Feb. 8, 1892.
Employs a series of normally insulated contacts arranged at considerable distances apart and elevated from one to three feet above the surface of the ground.

Switches and Cut-Outs:—

Switch for Electric Circuits, W. McNeill and J. H. Tinder, Winchester, Ky. 503,157. Filed May 31, 1892.
A design to be operated from a central station to extinguish the lights by a momentary interruption of the main circuit, and to be readjusted by means of a hand lever or coin operated device.

Electric Switch, E. P. Warner, Chicago, Ill., 503,180. Filed October 29, 1892.
A jack-knife switch for very heavy currents.

Telegraphs:—

Writing Receiver, A. Heil, Fränkisch Crumbach, Germany, 503,371. Filed Jan. 21, 1893.
A simple receiver and transmitter without electrical attachment for the use of beginners learning telegraphy.

Telegraphic Apparatus, A. Heil, Fränkish Crumbach, Germany, 503,372. Filed Feb. 13, 1893.
A telegraphic register in which the tape is uniformly advanced by a device actuated by the current transmitting the message.

Telephones and Apparatus:—

Test System for Multiple Switchboards, W. D. Allison, Chicago, Ill., 503,115 Filed May 14, 1888.
Employs a Wheatstone bridge and circuit so arranged that when a test is made the current will be sent through the galvanometer in one direction if the line is in one electrical condition and in the other direction if in the contrary condition.

Electric Switchboard Signal, F. A. Pickernell, Newark, N. J., 503,253. Filed May 16, 1893.
Relates to signaling circuits for use in connection with telephone systems.

Cabling System for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 503,555. Filed Oct. 15, 1888.
Relates to making connections and laying up the cables at the rear of multiple switchboards at telephone exchanges.

PATENT NOTES.

THE HOWARD INCANDESCENT ARC LAMPS.

We published last week the paper read by Mr. L. B. Marks, before the Electrical Congress, on the new Howard incandescent arc lamp. Patents covering the principle and method very broadly have just been issued to Mr. Louis E. Howard, of Plainfield, N. J. In one of these, No. 503,539, of August 15, with 11 claims, the wording of Claim No. 2 is as follows:

"An arc lamp having its electrodes around the arc inclosed in a small transparent or translucent envelope so arranged as to maintain the gases luminous in said envelope and air-tight against ingress of air, but affording egress for the heated gases developed by the arc."

We understand that the Royal Arc Company, controlling the Howard patents, is now making arrangements for the construction of a large factory at Plainfield, and has secured several acres of ground for the purpose.

"EFFORTS APPRECIATED."

A reader of The Electrical Engineer at Lynn, Mass. whom we have not the pleasure of knowing personally, writes us under date of August 18, 1893:—"Close observation for six months has convinced me that the Engineer is taking the lead as an electrical review for those engaged in electrical pursuits. Though a subscriber for another electrical paper, I often need to buy the Engineer to avoid missing valuable information. * * * The enterprise and excellence of the Engineer is certainly noticeable. If few take the trouble to say as much, you may still be sure that your efforts are being appreciated. Such a good showing bespeaks an enormous amount of energy and work; and increased financial success cannot but result."

VOTING AGAINST SUNDAY ELECTRIC CARS AT TORONTO, CAN.

The vote on the Sunday street car question at Toronto on Aug. 27 was the largest vote ever given by the citizens. The total vote was 27,311, of which 14,157 was against Sunday cars, and 13,154 for, making the majority against Sunday cars of 1,003. When the vote was taken on the same question in Jan., 1892, at the regular civic elections, there was a majority of 3,936 against. The Toronto Street Railway pays the expense of taking the vote, amounting to about $4,000, so that the city loses nothing by it. The hackmen are delighted.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE ACME OIL FILTER.

The Acme Oil Filter.

The accompanying illustration shows the Acme oil filter, made by the Acme Filter Co., of 620 Main street, St. Louis, Mo. The oil is poured in at the top, passes down through a filter check into the bottom of a water chamber, whence it rises through the filtering material and is drawn off for use at the top. A steam chamber is also provided to facilitate the process in cold weather by heating the water and oil.

These filters have met with the most flattering reception and the company publish a number of excellent testimonials from people using them. They are made in four sizes with capacities of from 5 to 50 gallons, filtering from one to 16 gallons respectively in 24 hours. There are no moving parts to wear out and the cleaning is easily and quickly done.

THE VALUE OF MICANITE.

The Mica Insulator Company, of 218 Water street, New York, have just issued a four page circular containing, besides a description of the specialties they manufacture, a number of very strong testimonials on Micanite from the leading manufacturers of electrical machinery. Micanite is fast being recognized as a first-class insulator in every respect. This company has passed the experimental stage, and is sending out an insulator made of pure sheet mica that cannot be excelled. They will be most happy to refer any one to the different companies who have adopted Micanite as an insulator.

Among the leading concerns cited, we note the Curtis Elec. Manufacturing Co., street car motors; La Roche Elec. Works, dynamos and stationary motors; the C. & C., Dahl, Card, Fisher, Riker, Jenney, Mather, Waddell-Entz, Eddy, Thomas H. Dallett, Baxter, W. S. Hill and other companies, while several letters come from local electric railway companies who use Micanite in their repair and renewal work, and would not be without it.

BALL ENGINES.

After a strong fight, the Ball Engine Co., Erie, Pa., through their New York office, have secured an order for a 100 h. p. Ball engine from the Brooklyn navy yard.

S. E. Olsen & Co., of Minneapolis, Minn., have purchased from Cooley & Vater, Minneapolis representatives of the Ball Engine Co., two 100 h. p. Ball engines.

CANADIAN NOTES.

Mr. T. W. Ness, electrical supply dealer and manufacturer, of Montreal, has taken into partnership Messrs. P. H. Davidson, J. L. Rankin, J. E. Adams and N. W. McLaren. The business will henceforth be carried on under the firm name of T. W. Ness & Co., with Mr. Ness as manager and Mr. Davidson as secretary-treasurer. The rapid increase of the business has necessitated, on the part of the new firm, the enlargement of the store as well as of the factory and the installation of a large amount of new machinery. The employees of Ness & Co. held their first annual picnic in a pleasant grove by the river at St. Rose on August 26th. Entertainment in the way of music and sports was provided, and the picnic was a most enjoyable one.

Mr. R. A. Ross has resigned his position with the Canadian General Electric Company, at its Peterboro works and accepted that of electrician of the Royal Electric Company at Montreal in place of Mr. Fred Thomson who has severed his connection with that company.

PHILADELPHIA NOTES.

Harry S. Smith & Co., Ltd., 607 Chestnut St., Philadelphia, have taken the agency for the apparatus of the Central Electric Heating Co., and expect to do a large business in this line.

La Roche Electrical Works, Philadelphia, are one of the very few concerns in any line of trade which through these dull times have run full hours with full force.

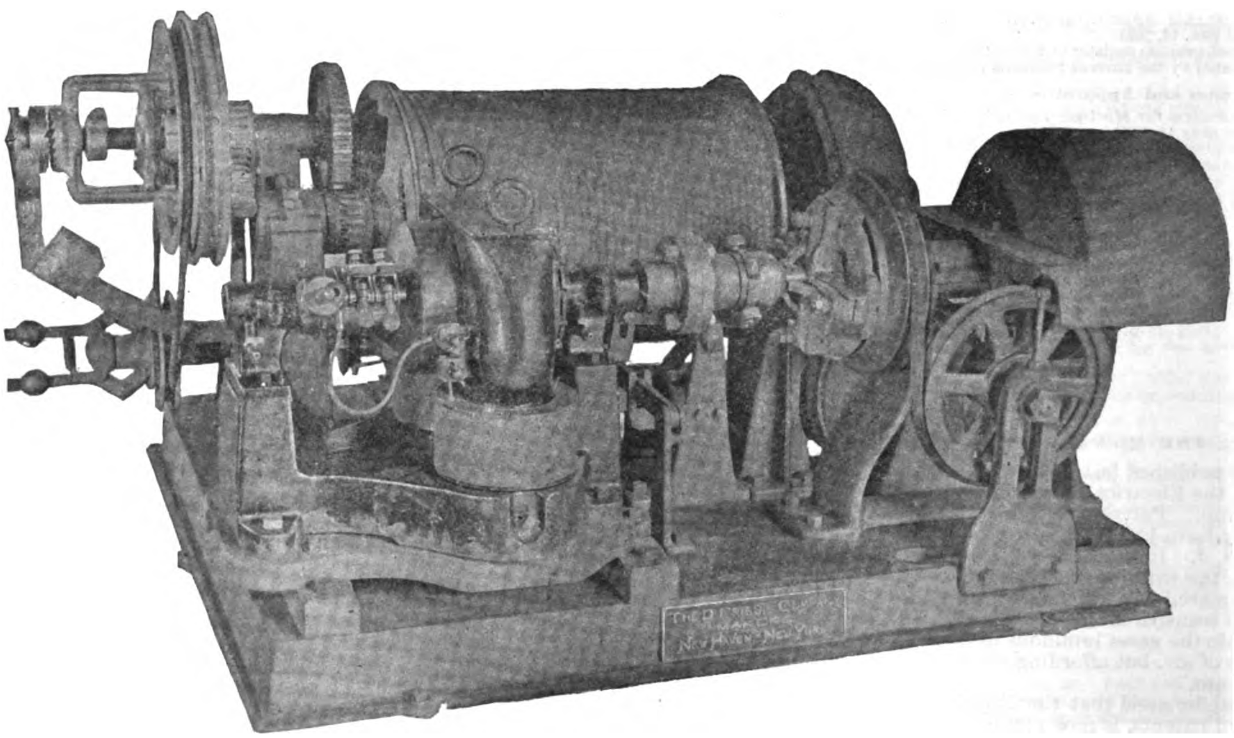
Mr. C. B. Crosby, formerly with Edison interests, has joined the forces of Harry S. Smith & Co., Ltd., as outside representative.

THE FRISBIE ELEVATOR AND MANUFACTURING COMPANY'S CONSTANT SPEED, DIRECT-CONNECTED ELECTRIC ELEVATOR MACHINE.

The invention of a constant-speed, direct-connected electric elevator that would be practical has been the aim of mechanics and electricians for years past, but there have been some difficult problems to be overcome, among which might be mentioned excessive use of current, the continued annoyance of blowing out fuses and the burning out of armatures.

The accompanying illustration shows a machine, in the production of which the manufacturers have spared no expense, and have overcome the objection of starting and stopping the armature every time the car is operated, by running the armature at full speed continuously in one direction during the hours of work.

By an ingenious invention, the Frisbie Elevator and Manufacturing Co. convert, from the motor to the screw-shaft, a reversible motion, and in connection with this use two friction clutches, one for hoisting and one for lowering. This gives the operator in the car perfect control over the machine, and he can start, stop and reverse it at will. He can also move the car to such a nicety that it can be started and stopped within a fractional part of an inch. By a stop motion on the machine the car can be run at full speed, and is stopped automatically at the extreme end of the run.



FRISBIE CONSTANT SPEED, DIRECT CONNECTED ELECTRIC ELEVATOR.

The slack cable stop, in the event of the car meeting an obstruction in its descent, engages a clutch at the end of the drum shaft, stopping the machine instantly and locking it so that the operator can make no further descent until the machine has been examined and the ropes placed in their proper scores on the drum. In the event of the current becoming impaired for any reason while the car is descending with a heavy load, the speed governor on the machine, operating by centrifugal force, throws out the friction clutch and puts on a powerful brake, which stops the machine instantly.

With a view to reducing the friction to a minimum, they use their improved ball thrust collar on the screw shaft. The worm is cut from steel of selected stock. The worm wheel is extra heavy, machine molded and cast of phosphor bronze, making it very tough and durable. The drum is turned and grooved to fit the wire cables. These elevators only require a space of 4 x 6 to 5 x 8 feet, according to capacity desired.

These machines can be run at a high rate of speed, and yet the car be started and stopped very smoothly. They are used for both passenger and freight elevators, and the company also manufactures cabs or cars of all grades and styles, and also steam and belt elevators.

Among the company's installations, the following are a few of the most important: seven elevators for the United Dressed Beef Co., in their new abattoir building, 44th street and First avenue, New York City; two for the Constitution Wharf Co., Boston, Mass.; one for Cumner, Jones & Co., corner Chauncey street and Row place, Boston, Mass.; one for Huld Bros. & Co., wholesale grocers, Detroit, Mich., two for S. E. Olson & Co., a large dry goods house in Minneapolis, Minn.; one for S. F. Myers & Co., 51 Maiden Lane, New York City, and the factory is running full time and full handed in filling orders that are coming in almost daily. It is said, in fact, that they are obliged to increase their facilities in order to be able to accept the large amount of business offered them.

One point upon which the manufacturers lay particular stress is the claim that the machines are the only ones that do not in the least disturb or affect electric lights on the same circuit. The company's works are at New Haven, Conn.

NEW YORK NOTES.

Mr. A. J. MARTIN, manager of The West End Electric Co., Philadelphia, for the past three years, or since its erection, has accepted a position as manager of the Newtown Electric Light & Power Co., and assumed full control on August 20th. Mr. Martin will become a director in the Company. Mr. J. T. Hutchings will succeed Mr. Martin as manager of the West End Electric Co.

W. A. VAIL, 186 Liberty street, is now representing the National Elec. Mfg. Co., of Eau Claire, Wis., for both alternating and direct systems of electric lighting, and already has several good contracts in hand to beguile the dull times with.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY are making a specialty of Von Cleff & Company's all steel pliers, connectors and other electrical tools, and have on exhibition at their World's Fair space a very handsome sample board of these goods, including flat and round long-nose pliers, diagonal and end-cutting nippers, linemen's wrenches, etc. The advantage of the Von Cleff all steel goods over the English imported tools in this line is said to be that every article of the former is warranted, and replaced free of charge if it breaks down in doing the work for which it is sold, while the English goods are sold without any such guarantee, and if a flaw of any kind exists the purchaser is the loser thereby.

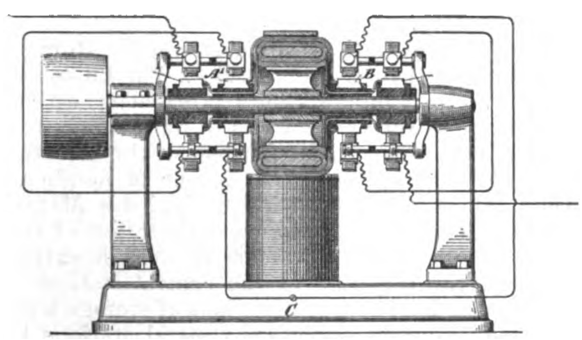
☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. SEPTEMBER 13, 1893. No. 280.

BRADLEY'S HIGH POTENTIAL DIRECT CURRENT DYNAMO OR MOTOR.

THE destructive action of high potential direct currents on the commutators of dynamos and motors has always been a fruitful source of trouble to the designers of such machines, and has, in fact, precluded their effective use. In a recent form of machine devised by Mr. C. S. Bradley,



Bradley High Potential Direct Current Dynamo.

however, the inventor has adopted the ingenious plan of mounting upon the same shaft an armature wound with a number of independent circuits, all of which contribute to the resultant effect through the medium of a number of commutators, the brushes of which are coupled together in such a way that the several windings will be in series relation to one another. The dielectric strain upon the wire insulation is reduced by connecting some intermediate point of the internal circuit with the frame of the machine. The windings are highly insulated from each other and so arranged that parts of the windings which lie in close juxtaposition upon the armature will have as low a difference of potential as is compatible with a symmetrical system of winding.

Each commutator has a large number of segments in order that the potential difference between any two adjacent ones may be as small as possible and yet the aggregate difference at the brushes may be high. Each has a pair of brushes. In the machine shown in the illustration, it will be seen that two brushes of opposite sign are connected together and the remaining two are connected to the terminals of the machine. There will thus be thrown upon the line a current having an E. M. F. behind it equal to the sum of the E. M. F.'s developed by the two windings, and the dielectric strain between the frame of the machine and the windings would be equal to the aggregate E. M. F., a condition which it is very necessary to avoid, inasmuch as the insulation of that portion of the winding where the potential is highest is liable to rupture. In order to avoid this difficulty Mr. Bradley connects the frame of the machine with some portion of the circuit between the line brushes, so as to raise the potential of the machine and thus lower the dielectric strain by connecting the two brushes which interlink the two windings by a good, firm connection with the base of the machine. Thus if each winding develops an E. M. F. of a thousand volts, the frame of the machine will be brought to a potential of 1,000 volts and the strain upon the insulation will only be the difference between the final E. M. F. or 2,000 volts, and 1,000 volts, or just one-half of what it would be without the base connection. This base connection is indicated at C. In mounting the machine case is taken to highly insulate it from earth in order to prevent leakage from the base, which, under the system of connections described, will have a considerable potential.

"THE MOMENT OF REVERSAL."

BY

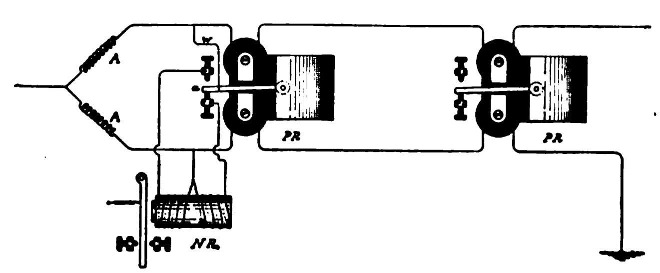
D. B. Grandy

In an article on the Quadruplex in The Electrical Engineer of August 16th, Mr. Maver describes Wicks' device for improving the neutral side, which, Mr. Maver says, "avoids entirely the moment or reversal."

A study of the diagram fails to show how it should do this, even theoretically, and a trial of the device gave, as I expected, a decidedly unsatisfactory result.

There are three distinct periods in the process of reversal in the polarity of a magnet: 1st. The discharge; 2nd. The period of no magnetism; and 3rd. The recharge by the other current. In a polar relay, the armature does not leave one side until the first two of these periods are passed, and the third has proceeded far enough to at least partially magnetize the cores. In a "Neutral" relay, on the contrary, the armature leaves its front stop as soon as, or a little before, the first period is completed.

Referring now to the diagram of Wicks' arrangement it will be noted that on reversal of current from the distant end, relays P R and N R will discharge simultaneously, and the armature of N R will fall away before N R is entirely discharged, remaining away during the second, or neutral period. During the third period, by the time P R attains sufficient magnetism of the other polarity to attract its armature, N R, will also have been partially magnetized by the same current; but at that moment the circuit through N R is broken by the armature of P R leaving its contact point, N R again discharges, and on the armature of P R reaching the other point, N R is recharged with the same



Wicks' Quadruplex Arrangement.

polarity it originally possessed. Thus, instead of shortening or avoiding the neutral period, Mr. Wicks' device practically lengthens it by introducing two changes of polarity instead of one. With a neutral relay having very large cores, this defect is not so pronounced, and may be overcome by the repeating sounder, but with those of ordinary size the break is very noticeable.

The great advantage of the Frier relay mentioned by Mr. Maver, lies in the fact that it does the work of the

extra coil and condenser, in Smith's arrangement, and of the "reversal coils" and extra magnet in that of Jones, without the use of any extraneous appliances. Probably in point of efficiency it is little, if any, superior to either of those devices.

STORAGE BATTERIES IN FRENCH CENTRAL STATIONS.

We have from time to time given details of the employment of storage batteries in central stations abroad, more especially in England and in Germany, where these adjuncts to the central station equipment have met with extensive application, though progress in the same line in this country appears to be very slow. The French electrical engineers, however, have also recognized the value of these auxiliaries with the result that numerous stations in France are now equipped with them.

The principal types of batteries in use in France are those of the Société pour le Travail Electrique des Métaux, and the Tudor storage batteries; in addition to these there may be mentioned the batteries made by Dujardin, Verdier, Gadot, Rousseau and the Société Française des Accumulateurs.

The storage batteries of the Société pour le Travail Electrique des Métaux consist of a series of plates built up of pastilles placed side by side and separated by a support of lead which is poured around them. The latter are then divided into smaller pastilles of about 2 centimetres square. The pastilles are separately prepared by means of a mixture of chloride of lead and chloride of zinc. This mixture is soaked in a dilute solution of hydrochloric acid which dissolves out the chloride of zinc. The pastilles are then dried and subjected to a hydrogene bath which reduces them to spongy lead. The positives are obtained by peroxidizing the negatives. The plates thus formed are suspended in the cells on their upper ends in order that the plate may expand in all directions, and so that the active matter which falls is deposited at the bottom without forming short circuits.

The Tudor accumulators are already well-known and have been fully described in these columns. For more than a year they have been regularly manufactured in France. The electrodes consist of lead plates which are heavily indented. These are first submitted to a Planté process for about two months and the indentations filled up with minium and litharge. The plate is then slightly compressed and subjected to a second formation; after several months an excellent accumulator is thus obtained. The insulation and the separation of the plates is obtained by means of glass tubes.

The plates of the Dujardin battery are built up of lead strips 6 millimetres wide and 1 millimetre thick piled one on top of the other to form a plate. Upon this plate there is deposited electrolytically the product of the decomposition of an alkaline nitrate of lead. At the end of the process the positive electrode is covered with pure peroxide of lead. We will forego the descriptions of the other storage batteries as they are tolerably well-known, merely mentioning that of Tommasi of the multitubular type (familiar to our readers) which is now being tried experimentally for lighting railway cars in Paris.

The Tudor batteries for stationary work have a capacity of 5.34 ampere hours per kilogram of plate when delivering at the rate of one ampere per kilogram, the discharge being stopped at 1.85 volt. A discharge of two amperes per kilogram of plate can, however, be obtained; their capacity ranges from 20,000 to 30,000 ampere hours. The manufacturers guarantee an ampere efficiency of 90 per cent. and a watt efficiency of 75 per cent. In actual practice, these figures are, it is said, often exceeded, and it is by no means rare that the ampere efficiency is 92 and the watt efficiency 80 to 82 per cent.; the discharge is stopped when the potential falls below 1.85. The Tudor Company has constructed a special type for electric traction, the maximum output of which, during normal running is three amperes per kilogram of plate.

The batteries of the Société des Métaux have a capacity of 18.5 ampere hours per kilogram of plate when discharging at the rate of one ampere per kilogram. The type employed on the Northern Street Railway of Paris, gives an ampere efficiency of 85 per cent. and a watt efficiency of 73 per cent. The Dujardin batteries have a useful capacity of 18 ampere hours per kilogram of plate when discharged down to 1.8 volt.

The batteries of the Société des Métaux are employed in Paris in the sector or district of the Popp Company. Twenty-five sub-stations are distributed in this sector. Each of these stations contains one, two or three batteries having a capacity each of 2,0·0 to 3,000 ampere hours. All these sub-stations are charged in series by the central station situated in the Boulevard Richard Lenoir, and which are equipped with Desroziers dynamos. Each of these substations distributes the current to the districts in its immediate vicinity.

The other central stations in Paris employ storage batteries to help out their regular service. The Edison station has a Tudor battery of 175 kilowatts capacity established in a sub-station at the extreme end of its sector in the Rue de Chateaudun. The central stations of the Société d'Eclairage et de Force par l'Eléctricté, four in number, have each three sets of batteries of the Société des Metaux, of 2,000 ampere hours each. The central station of the Sector Clichy also has a Tudor battery of 456 kilowatts.

In general, the majority of the central stations established in France have one or more sets of storage batteries. Thus, we may mention among the central stations having Tudor storage batteries, those at Angoulême, 15.6 kilowatts; Bordeaux, 19 kilowatts; Carcassonne, 60 kilowatts; Lyons (Gas Company) 60 kilowatts; Lyons (Tolozan) 18 kilowatts; Lyons (Bissuel) 12.25 kilowatts; Lyons (Bellecour), 16.75 kilowatts; Narbonne, 42 kilowatts; Rouen, 89.6 kilowatts; and St. Etienne, 79 kilowatts.

We have here mentioned only the principal installations; as a matter of fact it would appear that at the present time the utility of storage batteries in central stations is so well recognized in France that no new station is there established without providing for one.

HIGH TENSION CORTINUOUS CURRENT TRANSMISSION IN SWITZERLAND.

With reference to Prof. F. B. Crocker's very interesting address at the congress on high tension continuous current work, it interesting to note that the latest long-distance transmission plant in Switzerland is that recently opened at Frinvillier. The water power at that place averaging about 350 h. p., is transmitted to a paper factory at Biberist, a distance of nearly 18 miles. There are two continuous current dynamos connected in series, it is said, supplying a current of 43 amperes and 3,000 volts, so that a total voltage of 6,000 is carried by the overhead line. The latter consists of two copper wires, each 7 mm., or about 0.28 inch in diameter, carried on porcelain insulators on 30-foot poles. A direct telephone line connects the stations.

Operating Canal Locks.—The plans of Mr. Munro, C. E., for opening and closing the lock gates of canals by electricity, have been tried on the Beauharnois Canal. The experiment was entirely successful and demonstrated the advantages of electric motors for this purpose. The gates were easily closed or opened by the motors in about one minute, an operation which takes four men three or four times as long to accomplish by hand. As a result of this trial, electric power is to be adopted for the lock gates of the nearly completed Soulanges Canal on the St. Lawrence River some thirty miles above Montreal.

WORLD'S FAIR DEPARTMENT.

THE TELEPHONIC EXHIBIT OF CH. MILDÉ, FILS ET CIE.

In the French Section at the north end of the Electricity Building, MM. Ch. Mildé, Fils & Cie., of Paris, France, show a very complete and well finished display of telephonic and other apparatus. The display includes several types of telephones comprising a complete equipment for local, interurban and domestic telephonic communication. The Mildé instruments have been largely employed in France for all the above-mentioned purposes.

In all the Mildé telephonic apparatus the transmitter is a microphone of the type shown in Figs. 1 and 2 which has been constructed with the object of allowing of the direct transmission of the sound waves without passing through the intermediary of an induction coil. The adoption of this principle appears to have been very fruitful of results, and to allow of installing telephone stations very economically. For instance, in a small domestic service or even in a city exchange, batteries situated at the exchange are able to furnish the necessary current, thus obviating the necessity of giving each subscriber a battery.

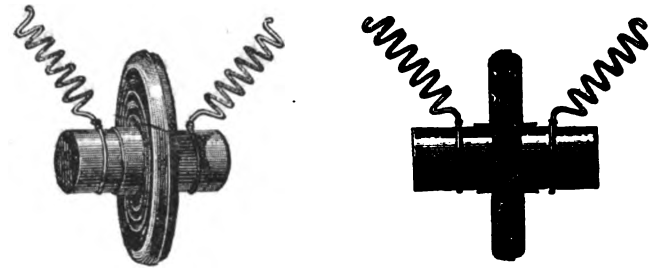
The Mildé microphone consists essentially of two short carbon cylinders inserted, respectively, in the two halves of a small metallic aneroid box, but insulated from them. The little box is filled to about five-sixths its height with carbon granules. One of the carbon cylinders is fixed to the vibrating diaphragm of wood and a neck or groove on each carbon cylinder serves for the attachment of the line wires; finally, the interior faces of the carbons are scored lightly in order to afford a better contact with the carbon granules.

When the transmitter is unhooked for service, a weak current passes, on account of the nature of the material

The Mildé Telephone Exhibit.

employed. When the diaphragm is spoken to, however, the following action takes place. The air vibrations are taken up by the wooden diaphragm, which carries with it in its movement one of the carbons which is attached to it, as well as the metallic shell in which the latter is inserted, and there is a recoil. On account of the inertia, the back part of the box vibrates with less intensity than the front part; there results from this a microscopic flattening of the microphone box, and the current passes in greater strength to the line, with corresponding effect on the receiver at the other end.

The simplicity of this apparatus, the small dimensions of the telephone set, its power, the small cost at which it can be manufactured, and the facility with which it can be attached to existing call-bell wires for domestic work, have



Figs. 1 and 2.—Mildé Microphone Transmitter.

naturally led to its widespread adoption in Europe and especially in France.

One form of the Mildé telephone receiver, like nearly all foreign receivers, is of the bipolar type, with bobbins wound on cores no larger than $\frac{3}{8}$-inch long and $\frac{1}{16}$-inch in diameter. These cores are attached to an open steel ring having arms running to the centre, so that the ends of the cores are presented to the centre of the diaphragm.

The firm also exhibit single pole telephones, and the complete telephone set constructed specially for the French Government exchanges. In these an induction coil is included, in order to conform to the specifications of the French Administration of Posts and Telegraphs.

In the centre of the space there is a reproduction in miniature of the French system of lightning conductors applied to a building. The attracting points are short and numerous and the chimneys are specially guarded owing to the greater conductivity possessed by the hot gases emanating from them. The conductors are flat copper ribbons, to insure against oxidation and obtain good contact. Taken as a whole the system fulfills in all its essentials the requirements which have been shown to be necessary by the classical experiments of Dr. Lodge. This system has been in use for a number of years in France and it is claimed that no building protected in this manner has ever been damaged by lightning.

In addition to the apparatus described there is a variety of others, such as annunciators, call bells, thermostats, etc. One of the thermostats is so arranged that it can be used for a push button and thus it serves a double purpose. This interesting exhibit is in charge of Mr. G. Pellissier.

OLD LAMPS IN THE EDISON LAMP EXHIBIT.

We have already described the highly instructive exhibit of incandescent lamps shown in the space of the General Electric Company. This exhibit, it will be recalled, includes lamps of every conceivable shape, candle power and voltage, and illustrates in a marked degree the wonderful perfection to which incandescent lamp manufacture has been carried; indeed we are informed that the Edison Lamp Works have never yet refused to fill an order, no matter what the specifications and drawings called for. The result is that the cases contain numerous types of

lamps which could only have been conceived in the brains of that numerous class usually termed "cranks."

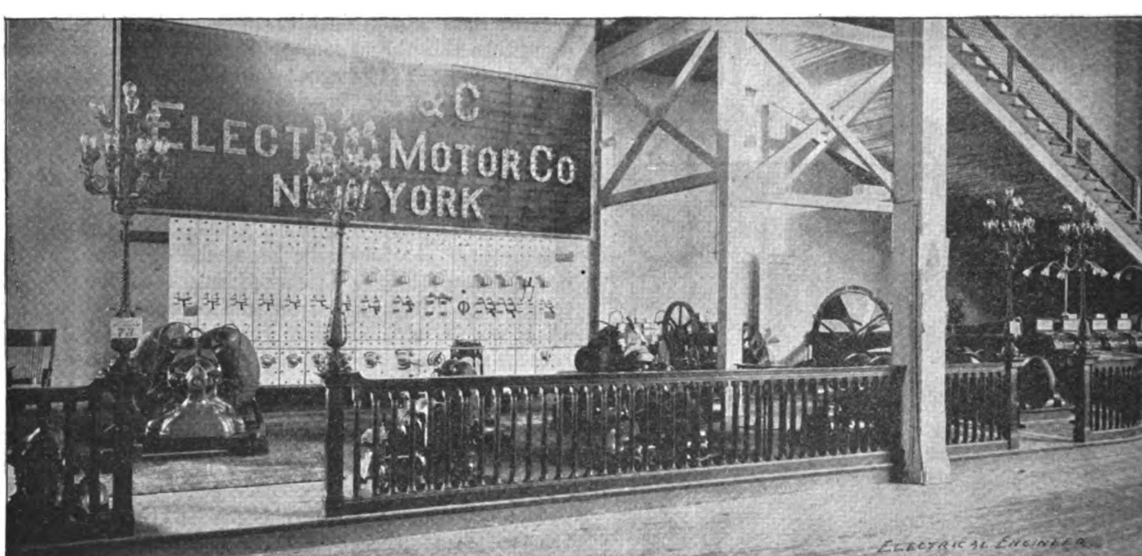
There are two cases, however, which contain lamps that possess more than a passing interest owing to the fact that they illustrate in a remarkable degree the life of carbon and its constancy. These lamps were made in 1880, and still bear the original labels giving the voltage of the lamp when running at 16 c. p. They were employed in the pump room of the Edison Lamp Works and were used as resistances to graduate the current supplied to the lamps that were being exhausted on the pumps. The lamps were in daily use for over 10 years and possess the old platinum screw clamp for holding the carbon filaments.

After being taken down they were remeasured to determine the voltage which would now bring them to 16 c. p. The result showed that some of them read a few volts higher, while others gave a lower voltage than that indicated on the old label, but a large majority read practically the same now as they did in 1880 after 10 years of service. While in use the current that was passed through them was sufficient to bring them to a good bright red. They were also tested for their vacuum which was shown to be practically as good as when they were first made. These facts illustrate that carbon as employed in the shape of lamp filaments can be depended upon to remain practically constant for an indefinite period when employed as a resistance, while it also shows that with a platinum seal a vacuum can be maintained indefinitely. The apparent anomaly presented by the fact that the present voltages of some of the lamps read lower than that indicated on the labels, while some read higher, is probably due to the imperfect methods of measurement employed at that early date.

THE C. & C. EXHIBIT AT THE FAIR.

The C. & C. Electric Motor Company occupy a conspicuous position in Electricity Building at the left of the south entrance and directly opposite the Western Electric Company's Egyptian temple. Current from a generator in Machinery Hall is brought to the large white marble switchboard shown in the engraving and thence to a 50-h. p. C. & C. motor coupled to a generator that supplies with current the other motors and the lights about the space. These range from 50 to ½ h. p. and are shown adapted to a variety of work. At the extreme right will be seen an exhaust fan five feet in diameter directly coupled to a motor arranged for four different speeds and near this is a Goulds triplex pump and motor on the same bed plate. A Sturtevant blower is also shown driven by a small motor mounted directly upon its shaft, while a number of small fan motors and other combinations add to the interest of the exhibit. The switchboard is, as has been said, of white marble and is arranged for 15 circuits, one panel for each, but only eight are at present in use on the various light and power circuits.

The display is well arranged and is particularly attractive at night when the illuminated sign is seen at its best and the graceful hammered iron standards at the two entrances are alight.



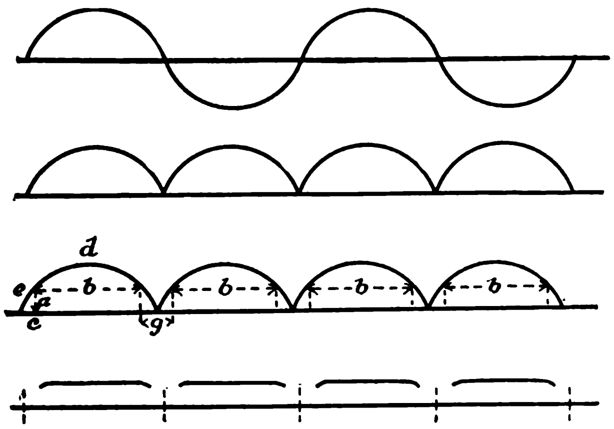
The C. & C. World's Fair Exhibit.

THE POLLAK COMMUTATOR FOR CONVERTING ALTERNATING INTO CONTINUOUS CURRENTS.

It is not so very long ago that the chief topic of discussion in electrical circles was the relative advantages and disadvantages of alternating and continuous currents, and while it must be admitted that the more recent advances have set aside many of the objections which were raised on both sides, the fact, nevertheless, remains that there are still some disadvantages met with, the removal of which would increase the value of both systems. Thus, for example, it would be of the greatest importance if alternating currents could be applied to the operation of street railway cars, and to electrolytic work, such as the charging of storage batteries, and the like. It was with the object of accomplishing this that Dr. Charles Pollak, of Frankfort-on-the-Main, Germany, devised an apparatus which he exhibits at the World's Fair and on which he touched lightly in a paper presented at the recent Electrical Congress. The object which Dr. Pollak has in view is of such paramount importance that a description of the apparatus will, we are sure, be read with great interest.

Before describing the apparatus in detail, we might premise that, as is well-known, if we have a commutator which runs synchronously with an alternating generator, a direct current is obtained, but which current is of a pulsating nature. A current of this character, however, cannot be used for charging storage batteries at all, while it is but very ill adapted to the operation of continuous current motors. This will be evident when we consider that in the case of storage batteries, the instant when the E. M. F. of the machine falls below that of the accumulators the latter would discharge current into the dynamo, and a similar action would take place with a continuous current motor which, during the period of low E. M. F. would operate as generator and would act as if a brake were being applied

to it. Now, Dr. Pollak conceived the idea that if, by some arrangement, only that part of the pulsating wave current could be taken off and utilized, the E. M. F. of which is



FIGS. 1, 2, 3 AND 4.

equal to, or higher than, that of the battery or motor, then nothing would stand in the way of the application of the alternating current for both the above-mentioned purposes.

The accompanying diagrams will serve to indicate the idea embodied in Dr. Pollak's apparatus. Fig. 1 illustrates the curve of E. M. F. of an ordinary alternating current machine, while Fig. 2 outlines the curve which would be produced by an ordinary commutator applied to an alternating machine. In Fig. 3 we will suppose the height *a* to represent the E. M. F. of the battery or of the motor, and *b* the interval of time during which that part of the current which is useful, is taken off. It will be noted that the E. M. F. of the pulsating current increases from zero at *c* up its maximum at *d*. During this period, however, at the point *e*, there is an instant at which the E. M. F. is equal to that of the battery or motor, and in consequence of which, no current passes in either direction; and if the circuit be opened or closed at that instant no sparking will take place, and, in a like manner, if the battery or motor be cut out at the point *f* no sparking will occur. In the time interval represented by *g* no current is taken, and the only loss entailed thereby is that due to the friction of the generator, since during that interval the generating machine runs without load.

But there is still another point to be considered, and that is, that a storage battery, for instance, has only a very small internal resistance, in consequence of which a very slight increase in E. M. F. causes a large and rapid increase in the current. Between the points *e* and *d* a considerable rise in E. M. F. takes place and if no precautions were taken a very heavy current would flow through the battery if the transformer or generator were capable of furnishing it.

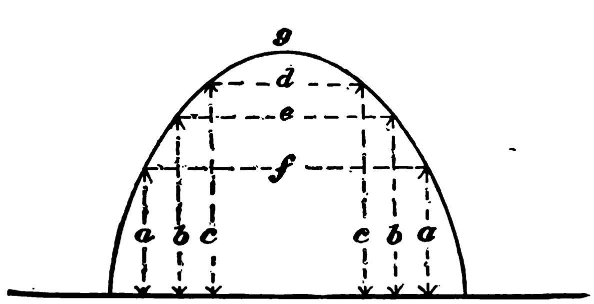


FIG. 5.

But if we employ a transformer of a watt-capacity about equal to the product of the E. M. F. and the nominal charging current of the battery, then the curve of E. M. F. delivered by the commutator will be flattened after the manner shown in Fig. 4 and this form of current can be readily applied.

But there remains still another point to be attended to. If, for instance, the counter-E. M. F. of the batteries or the motors always remained constant we could employ a simple synchronous commutator, having segments, the width of which corresponded to the time interval of current-taking and the insulating spaces between which could be arranged to correspond to the time interval *g*, Fig. 3. But as a matter of fact the E. M. F. of the battery changes as the charging proceeds and the points at which current is sent into the battery and cut off change, being shifted from *a* to *b*, or *c*, respectively, as shown in Fig. 5. The changed position of these points alters the time interval of current-taking as will be readily understood by an inspection of Fig. 5 where the lines *f*, *e* and *d* represent, in length, the interval of current-taking. Hence it follows that the commutator, in order to operate successfully, must be so arranged that the time interval of current-taking can be regulated, and it is this very important essential that Dr. Pollak has provided for in his device.

A shifting of the phase takes place corresponding to

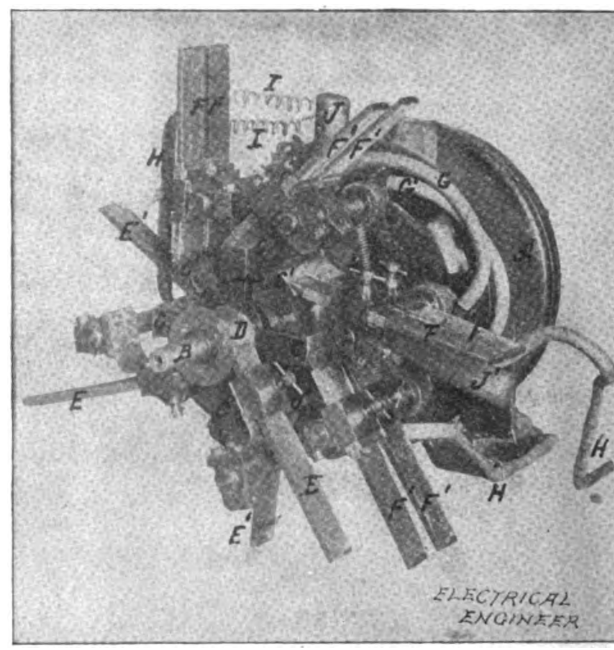


FIG. 6, POLLAK COMMUTATOR.

every change in the strength of the current. But as the centre of the current impulse taken off, for instance, *f*, Fig. 5, must correspond in time to the highest point *g* of the current curve, the current impulse must be taken off not only during a particular time interval, but also beginning and ending at certain definite instants.

The apparatus which accomplishes all this is illustrated in the engraving Fig. 6 and has been shown in operation at the World's Fair. It consists of a small $\frac{1}{10}$ h. p. synchronous alternating motor A, which carries a long shaft B on the end of which, but insulated from it, an 8-segment commutator is fixed. These segments C C C C are connected to a contact ring D while those marked C' C' C' C' are connected with another contact ring. Both these contact rings receive the alternating current from the brushes E E and E¹ E¹, to which are connected the wires H H leading to the alternating generator. The brushes which deliver the continuous current F F F F, and F' F' F' F', are so connected by flexible cables G and G' that the first pair F F is connected with the third pair F F and the second F' F' to the fourth F' F'. The distance between the pairs of adjacent brushes F F and F' F' is not regulable,

but the distance between the first two pairs and the second two pairs of brushes can be changed; they being so arranged that they can be rotated around the axis of the commutator by means of the screw handles J and J^1. The wires I I carry current to the motor which is connected in parallel with the commutator. From this description it will be evident that according to the distance between the two pairs of brushes the contact between them and the commutator circuits will be shorter or longer. Thus in Fig. 6 the brushes are in such a position that the duration of the contact is $1\frac{1}{2}$ times that of the width of the segment, because, as will be seen, the third and fourth pair of brushes have passed half over the commutator segment, whereas

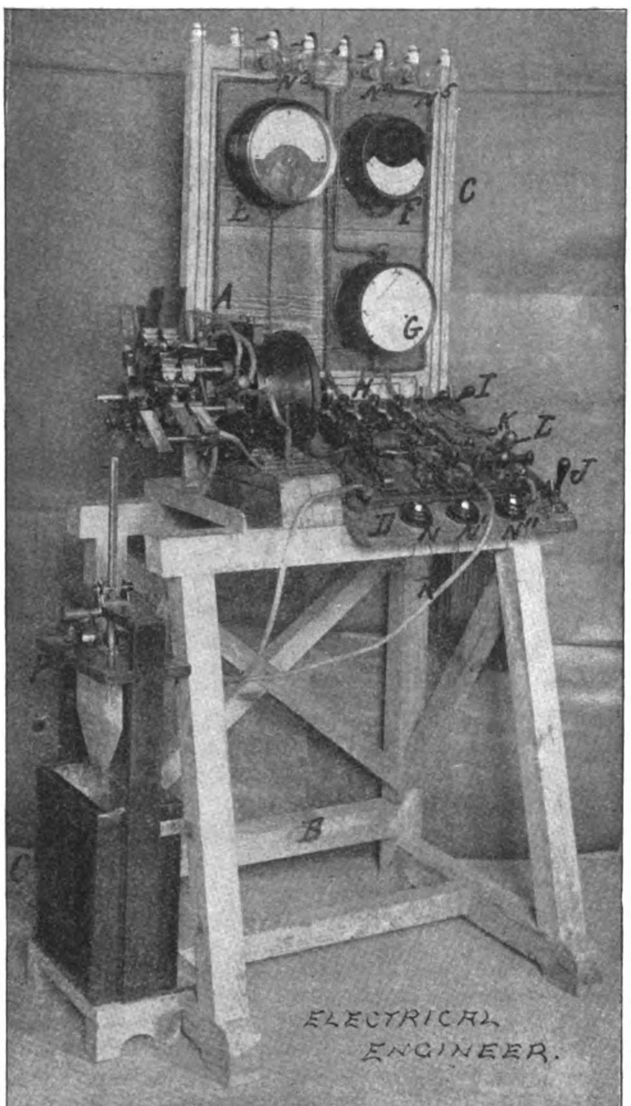


Fig. 7.—Complete Pollak Apparatus.

the first and second pairs have just come into contact; and since the brushes are connected together as described above, it follows that the contact will be interrupted only when the first and second pairs of brushes, counting from the top, cease to be in contact with the segments; of course, we are here now assuming that the commutator is in rotation.

The engraving, Fig. 7, represents a complete installation for changing alternating currents into continuous, equivalent to 8,000 watts capacity. The commutating device A is placed on a wooden frame B which also carries a switch board C and a board D to which are fastened an alternating voltmeter E, a continuous voltmeter F and an ammeter G. H are fusible cut-outs; I, a voltmeter switch; J, the motor switch; K, the reversing switch for the alternating voltmeter; L, the similar switch for the continuous current; M, an automatic cut-out used in charging storage batteries. N, N^1, N^2, are push buttons which are connected to the incandescent lamps N^3, and N^4 and N^5, and which lamps are connected in parallel with the liquid rheostat O. This rheostat has a switch P by means of which it can be short circuited and is connected by flexible cables R R with the commutator and the automatic switch on the switch board.

In operating this installation, current is applied to the synchronous motor which is brought up to synchronism by means or a hand-wheel or in any other convenient way, and in order to be sure that the motor is actually in synchronism the automatic cutout is closed and the commutator circuit closed on either side. The first push button N is then pressed, connecting with the two incandescent lamps N^3 which are connected in series. These lamps are each of a voltage equal to the potential of the machine. If upon pressing the button the lamps burn steady and with a uniform brilliancy it indicates that the motor which drives the commutator is in synchronism with the generator. If they burn brightly it indicates at the same time that the direction of the continuous current is the same as that of the accumulators, and hence, the current must be reversed for charging. When this is done the lamp N^4, which is of the same voltage as the first two, is only heated to a dull red. If we now press the third button N^2 then the lamp N^5 lights up, which is only of half the voltage of the preceding lamps; but it lights up owing to the fact that at the terminals of the lamp there now exists only the difference in potential between the machine and the batteries. Having determined these points, the plates of the liquid rheostat are lowered slowly into the liquid; if abnormal sparking is seen at the brushes, the latter are shifted until the sparking disappears and then the plates of the rheostat are short circuited, and the brushes again slightly regulated, which must be done whenever sparking appears.

With a well regulated alternated generator the brushes of the commutator require attention only during the first half hour of charging, but during five or six hours following they require no shifting whatever, and only toward the end of the charge, when the E. M. F. of the battery rises, do the brushes of the commutator again require regulation. The case is different, however, when the alternating generator does not operate uniformly or when the commutator delivers current to continuous current motors that are running with variable load or that are cut out and reversed frequently, as would be the case in electric railway work. In such case the brushes would be controlled by an automatic regulator consisting, in the main, of a solenoid, and then the machine would require but the very smallest amount of attention.

The question of the efficiency of this converting apparatus is one which suggests itself as being of an importance equal perhaps to that of its other qualities. Numerous tests have been made to determine that point, and it has been found to be very high, owing to the fact that the actual loss to be considered is that required to keep in rotation the little motor that drives the commutator; as this motor is only required to overcome the friction of the brushes the current lost in this way is exceedingly small. For example, in the machine described above, the actual consumption of energy is only 80 watts, while with a machine designed to convert 50 h. p., only 120 watts are required, which brings down the loss to one per cent. and under.

The measurements were made in the following way: First, the efficiency of the transformer was measured by passing the current of the secondary through a resistance. One wattmeter was included in the primary and a second wattmeter in the secondary and the transformer was shown to have an efficiency of 83 per cent. The second

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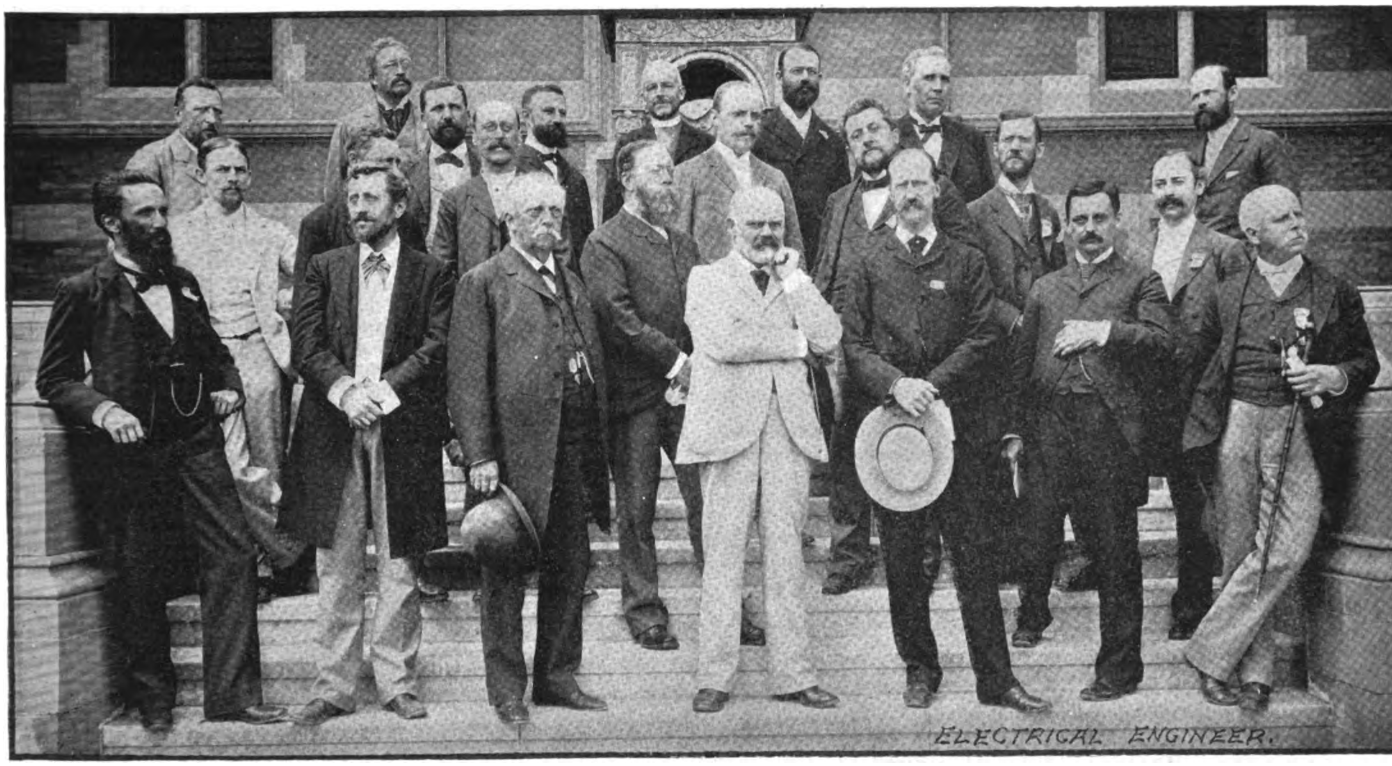


Lummer. Ferraris. Voit. Ayrton. Violle. Helmholtz. Preece. Palaz. Mascart. Rowland. S. P. Thompson. Thomson. Mendenhall.

The Chamber of Delegates at the Electrical Congress.

wattmeter was then put in circuit on the other side of the commutating machine to measure the continuous current delivered, and showed an efficiency for the transformer of 83.2 per cent.; in other words, the efficiency of the commutating device would equal to $\frac{83.2}{83.4}$, or more than 99 per cent. The low efficiency of the transformer itself was due to the fact that it was one of the older types of ring transformers, the only one available at the time. The motor which drove the commutator received its current from another transformer and the energy consumed by it is not included in the above calculation which was merely intended to determine the actual loss due to commutation pure and simple.

The importance of an apparatus such as the one we have just described must be apparent, and it is more than probable that we will soon find it applied to alternating current circuits. Indeed, the apparatus above illustrated, has been constructed for a plant in Spain, and others are in course of construction which will be employed in various central stations on the continent of Europe.

A GROUP OF THE OFFICIAL DELEGATES TO THE ELECTRICAL CONGRESS.

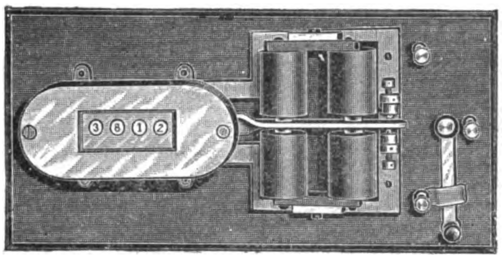
In the issue of The Electrical Engineer of Aug. 30, which contained the report of the proceedings of the Electrical Congress held at Chicago, we gave some sketches from original portraits in our possession of several of the leading electricians participating in the congress. We are now glad to supplement those sketches with a group portrait of the official delegates to the congress, taken from a photograph made at the English headquarters in the World's Fair—Victoria House. It is an excellent group. Unfortunately two of the delegates are missing—Sahulka and Chavez, but in other respects makes it an interesting memento of an interesting occasion.

A ROW OVER SIGNS IN ELECTRICITY BUILDING.

The Western Electric Company has brought suit against the General Electric Company and certain employés for $10,000 damages. The charge is the removal of signs belonging to the Western Electric Company from the Electricity Building in the World's Fair. The declaration recites that the Western Electric Co. placed electric lamp posts in the building, all but three of them to be equipped by the General Electric Company; and that the condition of placing the posts there was that signs bearing the Western Company's name should adorn the posts. These signs, the declaration avers, met with strong objections from E. J. Spencer, agent of the General Company, who endeavored to secure the removal of the glass signs. Finally, it says, five men, acting under the direction of the General Electric Company, took the Western Electric Company's signs out of the posts, substituting therefor plain glass sides. That was done, as the declaration says, the night of July 17. The Western Electric people were enraged and went to State-Attorney Kern with what evidence they had, asking him that a presentment to the grand jury be made, but Mr. Kern said that the jury had just been discharged. Then they sent the General Electric Company a bill for $500 for the signs, but they say it drew no response. The bill says five that employés of the General Electric Company failed to show up after the night of July 17 at the Electricity Building. The names of the five, made co-defendants with the General Company, are Hofstede, "John Doe," Henry Smith, James Rogers and William Wilson. The matter is one that is exciting considerable attention and comment in Chicago and elsewhere, coming as it does so soon after the exciting episode connected with the alleged stealing by the General Electric Co. of Westinghouse blue prints.

THE DURANT ELECTRIC COUNTER.

An interesting, though small, exhibit at the World's Fair, is that made by Mr. Walter N. Durant, of Milwaukee, Wis., who shows a number of electrical stroke and revolution counters, in



Durant Electric Counter.

the north gallery of Manufactures Building. They are designed for counting the revolutions of an engine, the number of sheets run off by a printing press and the like and indicating the result in the superintendent's office or at some other point distant from the machines themselves.

The principle of the electric counter is as follows: Three wires lead from the engine, or other machine, to two electromagnets on the counter which are alternately excited by means of a switch actuated by some rotating or reciprocating part of the machine at each revolution or stroke, as the case may be. The motion is transmitted to the counting mechanism by an armature acting between the two magnets as the circuits are made and broken by the switch. The dials are discs numbered from 0 to 9, and the shaft of each carries between the bearing plates a toothed wheel and drum, and all except the last a "wiper" or single tooth. A pawl, actuated by the armature engages a star on the units shaft, moving it forward one-tenth of a revolution at each stroke. At the tenth impulse the single tooth engages the next gear wheel and moves the corresponding dial one point, and so on through the entire train.

In addition to this mere display of these interesting devices, several others are in actual operation in Machinery Hall.

The official designation of the Manufactures Building display is Section E, Column T—148.

BLISS PRESSES AT THE WORLD'S FAIR.

The firm of E. W. Bliss & Co., of Brooklyn, whose presses for stamping and cutting metals have been so often illustrated in The Electrical Engineer, have a most interesting World's Fair exhibit in the Annex to Machinery Hall. This company make a specialty of machinery for the stamping, shaping, cutting, punching, embossing and perforating of sheet and other metals, and are said to be the largest manufacturers in that line in the world.

Some of the many uses to which they adapt their machinery are aptly illustrated in the exhibit, where they manufacture quite a number of articles before the eyes of the public.

The most noticeable thing in the exhibit is a No. 14 toggle drawing press weighing 80,000 pounds, standing 14 feet high and covering a floor space of 9x13 feet. It is shown at work cutting and drawing a number of tin pans from sheets at each stroke.

The manufacturers say that they have embodied in these toggle drawing presses, which they make in 14 sizes, such constructive improvements over the cam drawing press that the latter variety is now everywhere being superseded by this newer type of machine, which is the patented property of the E. W. Bliss Company. The advantage can be briefly stated as consisting in the expenditure of less power and wear, while at the same time attaining greater accuracy and smoothness of action.

A smaller toggle drawing press, their No. 3½, weighing about 12,000 pounds, is also shown in operation, performing even more complicated work than the large press, inasmuch as it not only draws two pans at each stroke, but also cuts simultaneously out of the square tin plates the round blanks which are required for the purpose. Another press makes aluminum bronze souvenir spoons and attracts much attention and interest from the visitors, and still others are shown making various other sheet metal articles.

Exhibit of E. W. Bliss Co. at the Fair.

The exhibit cannot fail to be of interest and advantage to manufacturers and engineers.

THE NEW WOOD LIGHTING PLANT AT DECATUR, ILL.

The Municipal Electric Company at Decatur, Ill., with a capital of $25,000, has put in a fine new plant of the Wood apparatus built by the Fort Wayne Electric Company. It comprises two 60-light arc machines and a 1,500 light alternator, driven by a 300-h. p. St. Louis Corliss engine and Oakes horizontal boilers. The line wire is of "Shield Brand," and the power house is of brick. J. H. Culver is president of the company; J. M. Willard, vice-president; E. E. Gibson, secretary and treasurer.

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THE ADVANCE IN INSURANCE RATES.

CONSIDERABLE feeling and interest has been aroused at Providence, R. I., by the announcement of a 20 per cent. advance in fire insurance rates based largely if not wholly upon the greater dangers alleged to be due to the increasing use of electricity and the multiplication of electrical wires in the streets. It appears that the assessors' figures for 1892 show the valuation of real estate in Providence to be $114,656,860. If this property is insured at 75 per cent. of its value, the insurance risk would amount to $85,992,645. The average rate of insurance being about 1 per cent., property owners pay annually $859,926. An increase of 20 per cent. will increase that amount by $171,985. This is no mean increase, and the community is said to be greatly agitated on the subject. Nor does Providence stand alone in this respect Rates are being raised in a similar manner all over the country, and in every instance, so far as we are aware, electricity is the bugaboo of the underwriter. What are we going to do about it?

Now, admitting that the underwriters have only seized on electricity as a pretext for higher rates because the fire insurance business has been in a rotten condition that dates back far beyond the introduction of electricity for light or power, duty requires that the facts supporting these charges as to the dangers of electricity should be dealt with. The silver purchase law has not been the only cause of recent financial trouble in this country, but once repealed, it will be easier to restore public confidence and deal with other evils. So, too, with the indiscriminate stringing of electrical wires. If the underwriters can be met on their own ground, and the abuses they complain of be removed, the way to lower, healthier rates will be easy, and the deserved popularity of electricity will be greater than ever.

First of all, there are, as the underwriters contend, far too many overhead wires in the streets. There should not be allowed a single telegraph, telephone, or signal wire overhead in any large city in the country. They can be better and more continuously operated underground than overhead, and no plea for ærial wires along or across streets should be listened to.

That large class of wires disposed of, simply the electric light, electric power, and electric railway circuits are left, all of which are of stronger construction than the first class, and will be far less liable to give trouble when their fragile companions are removed. But it cannot be denied that to-day many of the wires in this second group can be put underground. It settles down in most places to a mere question of expense and return on investment.

Up to the present time, the trolley electric railway system has maintained its position because it is an enormous public convenience and because there is nothing yet ready of approved ability to take its place. We believe, moreover, that were there no overhead telegraph or telephone wires, the trolley would not be and could not be the cause of a single fire. In some places, stationary power motors are run off the 500-volt railway circuits, but in those cases ordinary precautions should suffice, and if they did not an advanced rate would be fair. Until storage battery traction or underground conduit systems are perfected, the trolley wires will increase in proportion to the increase of population; but in themselves they are no greater enemy of life and property than are the elevated roads.

When we come to interior wiring we find a state of affairs much to be deplored, but even here marked improvement is to be seen, and the raising of rates will only help the good work along. One step should be insisted on and that is the cessation of the practice of putting wires in plaster. They should be permitted only in tubes or moulding, and whenever they go in the walls they should run through tubes. Our columns present this week a splendid instance of tube work, and of the kind that the state of the art should enable every house owner to enjoy. We are ready to favor strong legislation compelling the use of wireways in buildings, and are glad to note that the Underwriters' International Electric Association have just placed themselves on record in support of insulating wireways that render concealed wiring permanently accessible.

The best way to meet the underwriters and their advancing rates is to deprive them of even the few arguments they now find against electricity in the cheap and bad work done.

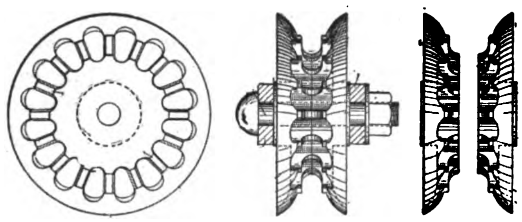
CONTINUOUS FROM ALTERNATING CURRENTS.

WHILE discussion as to the relative merits of the polyphase and single-phase alternating systems of power distribution was going on at the Electrical Congress, there was shown in operation in the Electricity Building, at the World's Fair, a device intended to put a stop upon all such discussions by affording practical relief from all the troubles and disadvantages brought out by the various speakers. We refer to the commutating device of Dr. Charles Pollak upon which that gentleman read a brief statement before Congress and of which we give a detailed description on another page. The idea of commutating the alternating current into a continuous one, operating continuous devices such as motors, is by no means new, but the practical difficulties which have heretofore been met in applying such a method were so great as to make its consideration out of the question. The ingenious device of Dr. Pollak appears to embody principles of construction to meet most, if not all, of the conditions encountered in alternating current work, and the possible influence which this apparatus may have on the future of alternating current distribution, as pointed out by Prof. Forbes, makes it worthy of the closest scrutiny and study.

ELECTRIC RAILWAY DEPARTMENT.

THE CLARK ICE-CUTTING TROLLEY WHEEL.

A new form of trolley wheel designed for the purpose of keeping the wire free from ice and sleet during winter storms has been devised by Mr. John W. Clark, of Menands, N. Y., and is



Clark Ice-Cutting Trolley Wheel.

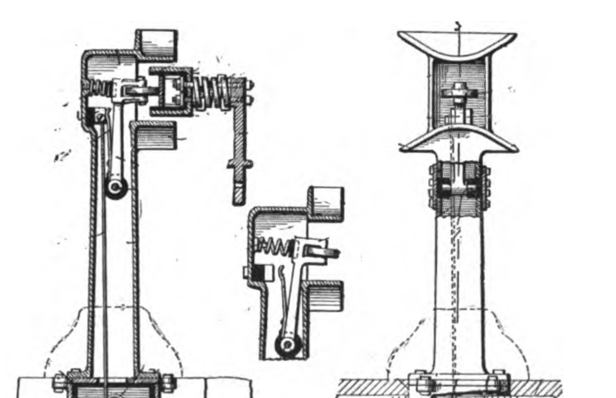
shown in the accompanying drawings. It will be seen that the spokes of the wheel are formed by radial openings cut through the flanges and also through part of the periphery of the hub, across which they extend and form a series of ice-breaking ridges at the bottom of the groove. This groove is of a size to fit the wire rather snugly, and between it and the flaring flanges of the wheel each spoke is provided with a sharp shoulder which aids in breaking part of the ice before the wire has actually made connection with the wheel.

It will also be seen from the drawings that the wheel may be made in two sections joined together.

THE BATES LOW POST ELECTRIC RAILWAY.

With the object of superseding both the overhead trolley and the underground conduit systems of electric railway, obviating the difficulties and annoyances sometimes encountered from the maintenance of constantly charged bare conductors, Mr. Joseph W. Bates, of Minneapolis, Minn., has devised the arrangement shown in the accompanying illustrations, in which normally insulated contacts are provided at considerable distances apart and elevated on short posts from one to three feet above the surface of the street at the side of the track.

It will be seen that Fig. 1 is an inside elevation of one of the posts partly broken away for clearness. Fig. 2 is a vertical section and shows the contact shoe in cross section and the yielding contact device in the post in position to conduct the current from the feed wire into the shoe and thence to the electrical apparatus upon the car. Fig. 3 is a sectional view of the head of the post



Figs. 1, 2 and 3.—Bates Low Post Electric Railway.

showing the contact device in its normal position. A feed wire pipe is arranged just below the surface of the road and each post rests upon a watertight base, fixed upon the end of a tie, within which the connection is made from the feed wire leading to the contact device at the top.

In each post is arranged an arm pivotted to a bolt insulated from the post. The upper end of the arm is formed in a yoke to receive the contact roller and a coil spring separated from the back of the yoke by a block of insulating material extends between the back and the outer wall of the head. This spring is adapted to force the arm forward into the position of Fig. 3 so as to hold the contact spring normally away from the contact block with which the feed wire is connected by the wire extending up through the post.

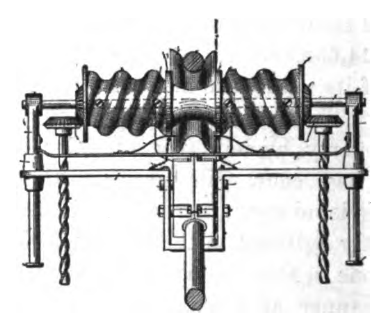
A shoe is carried at the side of the truck, shown in cross-section in Fig. 2, with its upper and lower plates extending out a considerable distance beyond the contact plate, injury to a person by contact with the rail being thus avoided.

The posts are ordinarily so spaced that the shoe will always be in contact with one of them, but, where this is impracticable, storage batteries may be carried by the car, supplying the motors with current during short intervals where posts cannot be placed.

THE JONES SCREW TROLLEY GUIDE.

An ingenious form of device for guiding to the trolley wire a displaced wheel has been recently produced by Mr. Henry C. Jones, of Montgomery, Ala., and is shown in front elevation in the accompanying illustration.

It will be seen that the guide consists of a frame supporting two spools, one on either side of, but normally below, the trolley wire and carried on the pole just ahead of the wheel. Each spool is provided with a helical groove having an inward pitch



Jones Screw Trolley Guide.

terminating in an inclined groove so that when the wire strikes this portion of a spool it naturally slides upon the guide pulley but not until the spools are raised to the proper height by means of the threaded parts at the sides actuated by bevel gears from the shaft carrying the spools. A washer holds the wire against the inclined end of the spool until the latter has risen to a point above the trolley wheel, when, by the tightening of a chain, the washer is suddenly drawn away and the wire drops upon the loose pulley in line with the trolley wheel and thence is transferred to the latter. The frame then falls by gravity to its normal position.

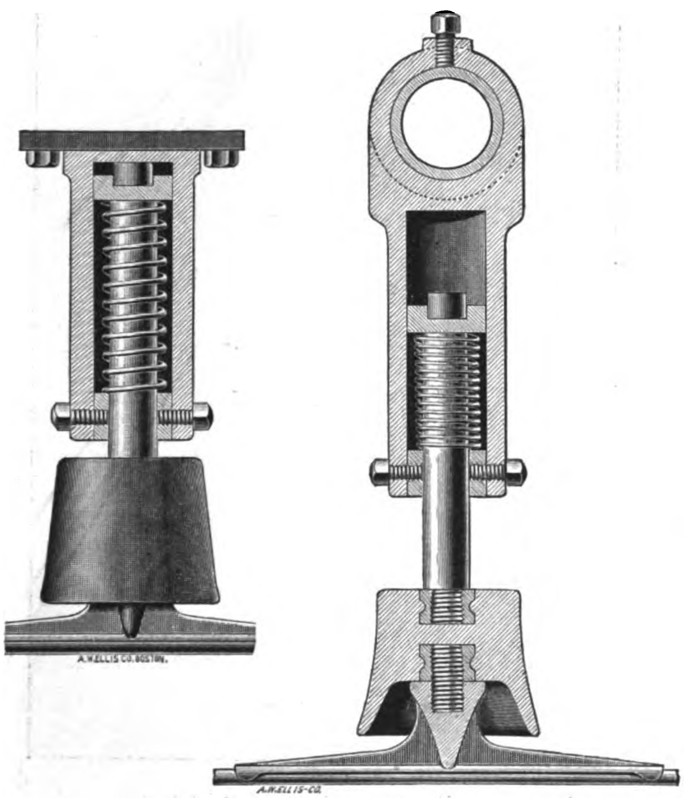
JUSTICE TO THE TROLLEY AND CABLE.

Why should there be the disposition to blame the cable cars, the electric cars,—every new thing in the way of the people's convenience in travel, for the mutilating or fatal accidents which occur to persons on foot, without any regard to the circumstances? Especially why should the conductors and motormen be abused when such an accident happens? A woman was run over on Friday by a Broadway cable car in New York City. She was drunk, and held a bottle of liquor clasped to her breast. She dropped the bottle, and seeking to recover it, fell forward partly on the track. The gripman had but a moment, but used that moment to push the woman back. He did push her somewhat out of the way, and saved her life by that; but she nevertheless fell so that her left arm and hand were crushed. Yet the accident brings the severest rebukes to the road and its employés. Similar things have happened now and then with our electric cars, but few of them have been properly attributable to any other than the person suffering from them. The boy who jumped off a wagon and ran just before an electric car across its track gave no warning that he was going to get into danger. The young man who did something very near like that and was killed had not shown any intention to cross the track until the moment he did it. The motormen, the conductors, on our cars, and usually in other cities, are careful and anxious to the last degree. They are

fully possessed with the responsibility of their positions. It is hard to charge them with murder for what they would have given anything to avoid. When a dereliction of duty is obvious and is made certain, the person guilty of it should suffer; but the cheap and indiscriminate blame bestowed on such men is to be seriously deprecated.—*Springfield Republican.*

THE BRENNAN TROLLEY WIRE HANGER.

The accompanying illustrations show a trolley wire hanger designed by Messrs. M. F. Brennan and P. F. Begley, of Lowell, Mass., and manufactured by the American Bolt Co., of the same place, of which Mr. Brennan is the general manager. It is designed for use on bracket arms and bridges, also under elevated railroad structures, its chief object being to furnish an elastic and yielding support for the trolley wire. It is made of iron, the lower part being in the form of a cylinder and containing a spring and spindle, the former made the proper tension to support whatever weight is required, and kept in place by means of a bushing fastened in the lower part of the cylinder with set screws. The



Brennan Trolley Wire Hanger.

spindle passes through the bushing and spring, its head resting on the upper end of the latter, and the lower end is threaded and screws into the top of the insulator to which the ear and trolley wire is fastened.

The weight of the trolley wire, ear and insulator varies from 30 to 40 pounds on each hanger, according to the distance the poles are set apart, and this weight on the hanger sets the spring. The pressure of the trolley on the under side is anywhere from eight to twelve pounds, according to the speed of the car and the condition of the track. When, therefore, the trolley is passing the hanger, with its pressure of eight, ten or twelve pounds, as the case may be, the spindle moves up, aided by the tension or strength of the spring, forming a cushion and saving the blow which the trolley would give to a rigid hanger.

ENGLISH CAPITAL FOR THE MONTREAL TROLLEY ROADS.

The Montreal Street Railway Company, which holds an agreement extending until the year 1922 for the use of the streets of the city of Montreal, is now raising in England a loan of £140,000 on 4½ per cent. debentures £100 each. The money is required for the purpose of doubling the existing lines and for the necessary outlay required for working the system by electricity. The assets are close upon £400,000, and the enormous increase of the business may be judged from the statement that whereas there were carried during the year 1888, 7,727,800 passengers, the first six months of the present year shows a total of 7,900,990 passengers. The dividends of the concern have never been less than 7 per cent., and one year reached 14 per cent., while the total debt of the company, including this issue, is a bonded liability of $1,000,000, there being no floating debt. The issue is one which should commend itself to people who seek a safe investment.

A ROAD TO THE RINGING ROCKS.

The success of electric roads running to places of special interest or beauty is now well recognized. A special dispatch from Pottstown, Pa., of Sept. 5, says:—The organization of the Ringing Rocks Electric Railway Company, a corporation composed of local capitalists, was completed here to day. The charter is dated September 1 and the capital stock is $100,000. The object of the new company is to build an electric road to and around a tract of 250 acres of beautiful woodland on which the famous ringing rocks are situated. The officers of the company are as follows: President, C. A. Goldin; vice-president, Samuel Fronheiser; secretary, R. E. Shaner; treasurer, A. K. Shaner; directors, Frank S. Brant, Hon. George C. Hollebauch, Jacob S. Bahr, David Sheiser and H. M. Boone.

THE WAKEFIELD AND STONEHAM STREET RAILWAY COMPANY.

The above company of Wakefield, Mass., has recently increased its capital stock from $50,000 to $150,000, with the object of making considerable extensions. It has five miles equipped with the Thomson-Houston overhead system and runs four motor cars and four trailers. Mr. C. F. Woodward is the president and Mr. J. F. Shaw, treasurer. The road has 50 pound tee rail. The proposed extensions are five miles to Lynn, three to Melrose and two to Reading.

RAILWAY WORK AT BINGHAMTON, N. Y.

The Binghamton Railroad Company has 22½ miles of its own, and controls 5 miles more of the Court Street, East End and West Side Railways. It has in operation no fewer than 65 cars of Laclede and Stephenson make, mounted on Bemis, Taylor and Brill tracks. The power house has a maximum capacity of 700 h. p. of Ball & Wood engine and Shapley & Wells boilers. The cars are equipped with Thomson-Houston and Edison motors. G. J. Rogers is the president of the company; John Evans, vice-president; J. B. Landfield, vice-president; C. O. Root, secretary; J. B. Rogers, treasurer, and J. P. E. Clark, general manager. The company is preparing to meet a large and rapid growth of patronage.

ELECTRIC RAILWAY DEVELOPMENT AT ELMIRA, N. Y.

The Westside Railroad Co. is now operating 7½ miles using the General Electric trolley system, and proposes to extend its track five miles. It has 18 motor cars and 22 trail cars, of Stephenson and Brill make. It has two 150 h. p. Bates-Corliss engines and 2 Payne 175 h. p. boilers installed with the generators in a brick power house. Another boiler and a 300 h. p. engine are to be added, and three more cars have been contracted for. C. M. Tompkins is president of the company, O. E. Ockley, vice-president, H. H. Hallock, secretary and treasurer, and W. W. Cole, general manager and superintendent. The company reports that six factories have closed contracts for electric lighting.

THE ALTON, ILL., ELECTRIC STREET RAILROAD CO.

The Alton Street Railroad Co., which has nine miles of track proposes an extension of another mile, and has contracted for the work and material. This company which has just gone into operation has a capital stock of $250,000, and added to its railway plant has 75 miles of lighting circuit. It has nine 18 feet cars of Dorner & Dutton make; with two Buckeye engines of 150 h. p. and two of 250 h. p. each. The plant is of the Brush and Sperry systems. J. F. Porter is vice president and general manager, J. G. White, treasurer, and J. H. White, secretary.

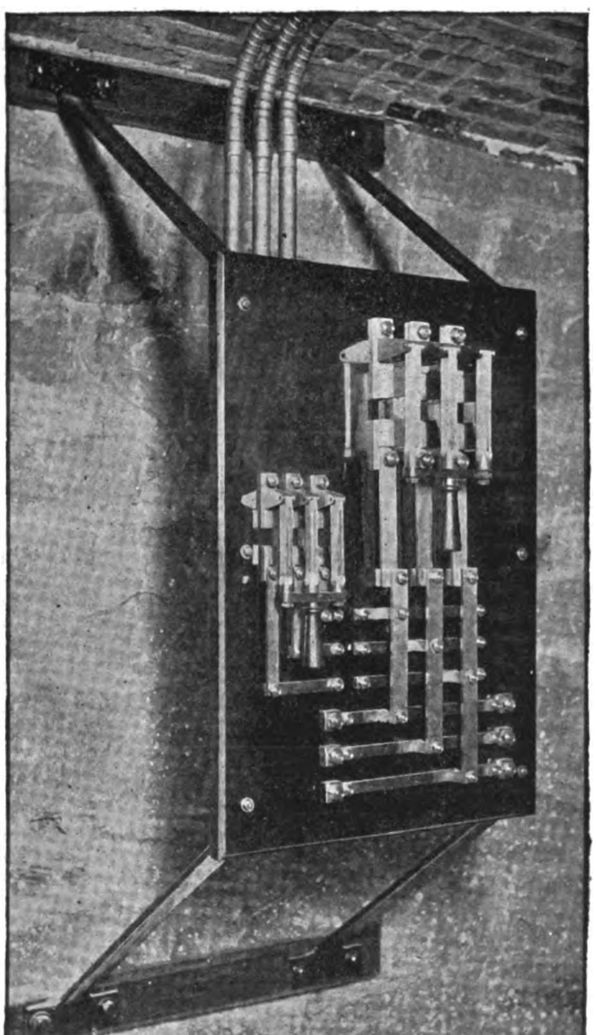
ELECTRIC TRACTION AT MAHANOY CITY, PA.

The Mahanoy Traction Co. has awarded to Stern & Silverman, of Philadelphia, Pa., the contract for the furnishing and equipping the power station complete. The plant is to consist of six 150 h. p. boilers, two 350 h. p. vertical engines and two 350 h. p. direct coupled generators. The plant is to be in operation by November 15th and the station arrangements will be the finest that the state of art at the present day can make them.

MISCELLANEOUS.

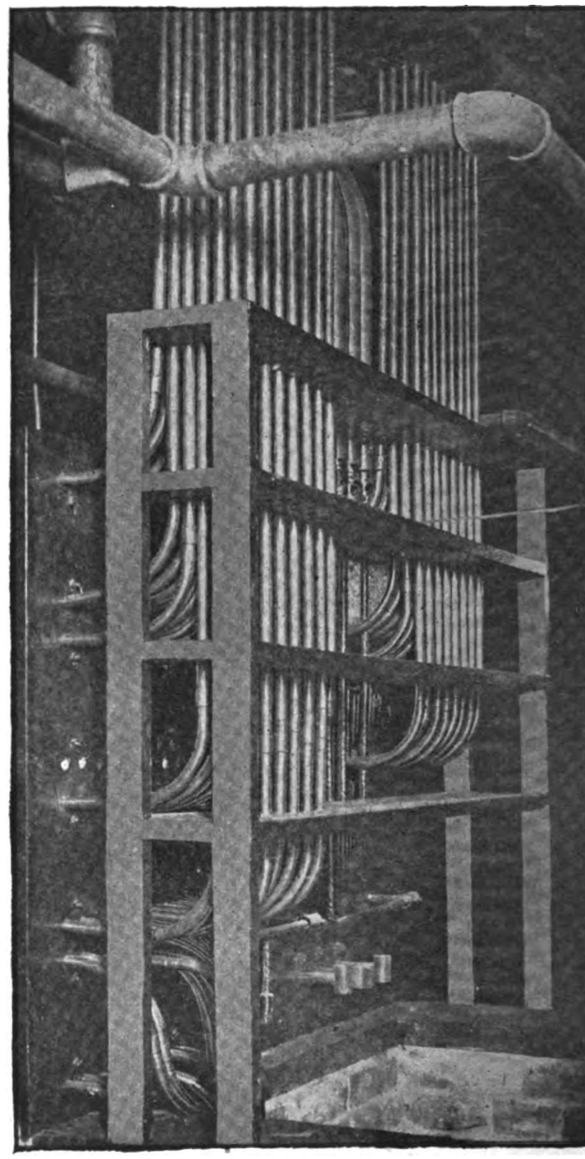
THE ELECTRICAL EQUIPMENT OF A MODERN RESIDENCE AT ERIE, PA.

ONE of the most complete installations of electrical wiring in a private house is approaching completion at the residence of Mrs. Charles H. Strong at Erie, Pa. The building is a four-story structure of Pompeiian brick and brown stone and is erected on a terrace facing a large park in the centre of the city. Fireproof construction has been used throughout and every device to successfully accomplish this end has been used. The building is divided into two wings by a large stair-well which rises to the roof. The heating will be by steam, both direct and indirect radiation, from boilers located in the stable at some distance from the house. The power plant is in a sub-basement and is isolated from the stable proper by fireproof walls and floors. All the steam, water, gas and electrical supply is controlled at the stable and carried through undergound ducts to the house. The building has been piped for both fuel and illuminating gas, and for an extensive system of water supply, drainage and ventilation. Owing to the character of the construction and the complication of this piping, the wiring has been an exceedingly difficult problem, necessitating the designing of a large number of special fittings and appliances. The wiring is on the three wire system with a double neutral, and at present current will be supplied from the station of the Edison Elecric Light & Power Co., of which Mr. Strong is president.



CENTRE OF DISTRIBUTION IN STABLE.

The overhead lines from the street are carried on light ornamental iron poles to the stable, where they descend through the last pole in lead covered cables to a fireproof vault in the sub-basement, where the main centre of distribution is located. On this centre are the main switches and cut-outs for both the house and stable, a set of mains being carried to a centre of distribution on the second floor, at which point are all the cut-outs for the stable circuits. From the main centre of distribution in the sub-basement of the stable, the house mains are carried in lead covered cable protected by iron pipe, to the house, where they are taken through ducts to the basement centre of distribution. From this point the sub-mains are carried to the various divisions of the building. On each floor are placed two centres of distribution, one for each wing of the building. The centres throughout the work are constructed of panels of black enameled slate, on which are mounted the cut-outs, switches and other distributing and controlling devices. The mains enter the centres through knife blade switches and the current is distributed to the cut-outs through polished copper bus bars. Each blade of the knife switches is provided with a separate handle so that either side of the circuit can be opened at will; but to prevent the neutral conductor being broken, an insulated bar is extended from the neutral blade, under the outside blades, and so arranged that when this blade is opened it breaks the entire circuit; this also prevents the outside blades from making contact before the neutral blade is in place.

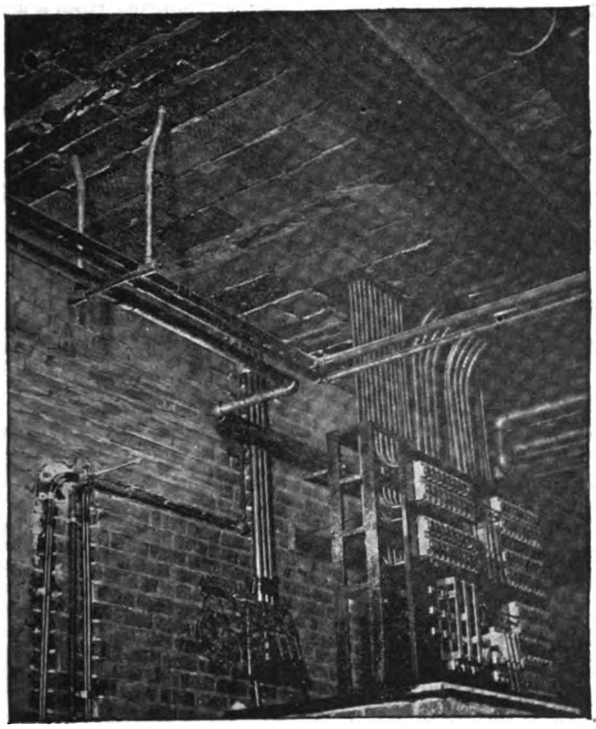


TUBING TO BASEMENT CENTRE OF DISTRIBUTION.

Each compartment throughout the building is supplied with from two to eight circuits, the cut-outs for these circuits being placed at the centre to which they are connected, there being no cut-outs in the house except those at the various centres. The cut-outs used are of the Edison plug type with porcelain bases. From the cut-outs the branch wiring for a compartment is carried to a special form of Cutter double-pole push-botton switch, and from this switch to the outlets, each set of outlets having an individual

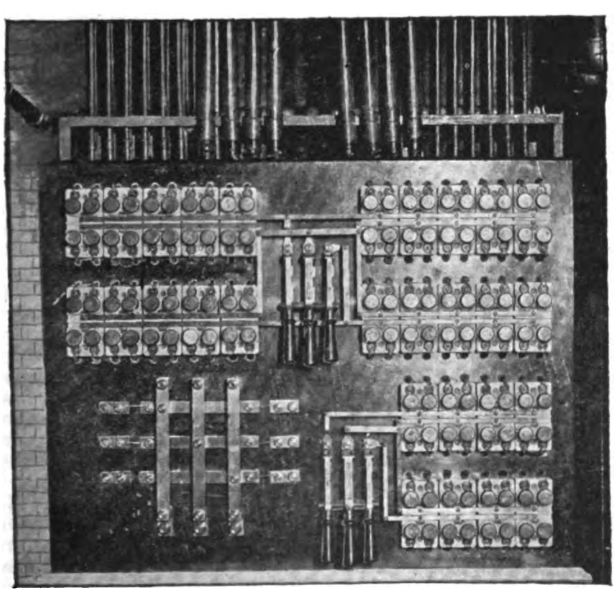
switch, set in a cast iron wall box which forms a support for the conduit.

Every outlet throughout the building is furnished with a special form of junction box for the support of the conduits.



BASEMENT CENTRE OF DISTRIBUTION.

These boxes are set even with the finished plaster line and have proved a practical method of assembling a large number of conductors at one point, eliminating the trouble and expense of a great number of elbows and giving ample space for the manipulation of the conductors. In many places where an outlet was not required with the present scheme of decoration, but where one would probably be required in the future, the boxes were set below the plaster line and provided with lids over which the

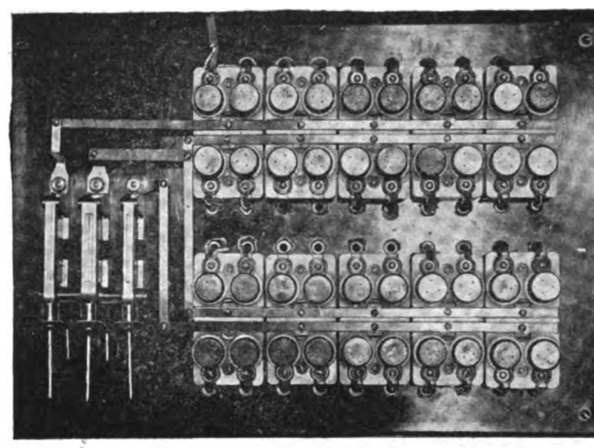


BASEMENT DISTRIBUTION BOARD.

plaster was finished. In addition to the required side and ceiling outlets, each compartment is provided with sashboard and floor receptacles for the attachment of standing lamps, fans or similar service.

The main ceiling outlet in every compartment is controlled independently of the regular switches, by a watch switch. The circuits are so arranged that when this switch is thrown the regular switches have no control of the outlets, so that in case of an alarm the entire house can be lighted from the owner's bedroom. This switch is supplied from the basement centre of distribution by an independent set of mains. The wiring for the call bell, burglar alarm, telephone and other signal systems is run in a similar manner to the electric light conductors and any or all of the wiring in the building can be removed without disturbing the decorations. The wiring is run in the brass covered conduit of the Interior Conduit and Insulation Company, with a single conductor in a tube, and Habirshaw rubber insulation is used on all conductors. The centres of distribution were constructed by W. H. Weston & Company.

The work was installed by the Edison Electric Light and Power Company of Erie, Pa., under the superintendence of Mr. Thomas O'Dea, the general manager of the company. Green & Weeks, Buffalo and New York, were the architects. The specifications and plans were prepared, the special appliances designed, and the installation carried out under the personal supervision and direction of the consulting engineer, Dr. W. A. Drysdale, 20 Hale Building, Philadelphia.



SUB-CENTRES OF DISTRIBUTION ABOVE THE BASEMENT.

The accompanying illustrations give an excellent idea of the character of the work, and show to what perfection the details of conduit wiring can be carried when placed in competent hands.

ELECTRIC CRANES AT BILBAO, SPAIN.

IN the August 25 issue of London *Engineering*, appears an interesting account of the construction of the immense harbor works at Bilbao, the capitol of the Basque Provinces, Spain, on the Nervion River, 7½ miles from the Gulf of Gascogne. The substructure was composed of a mound of rubble covered with a layer of immense blocks of concrete containing from 37 to 65 cubic yards each.

In 1888, says our contemporary, it was decided to adopt electricity for working all the plant required for making and handling the concrete blocks, and to this end a special traveling crane, transfer table, and loader were designed. To facilitate the handling of the blocks, two steel eyes were fixed in each block as it was being moulded. Heavy rails were placed between the rows of blocks for the traveling crane to run on. The construction of this crane is shown in Fig. 1, page 248. Considerable care was taken to get a good foundation for these rails, but there were nevertheless cases of settlement. This settlement required a very great increase in the power used in traversing the crane.

The dynamo supplying the current was driven by the 60 h. p. compound workshop engine, and supplied a continuous current at 220 volts, when running at 300 revolutions per minute. Bare conductors were used exclusively in distributing the current, and were fixed on insulators carried by posts or walls, as was convenient.

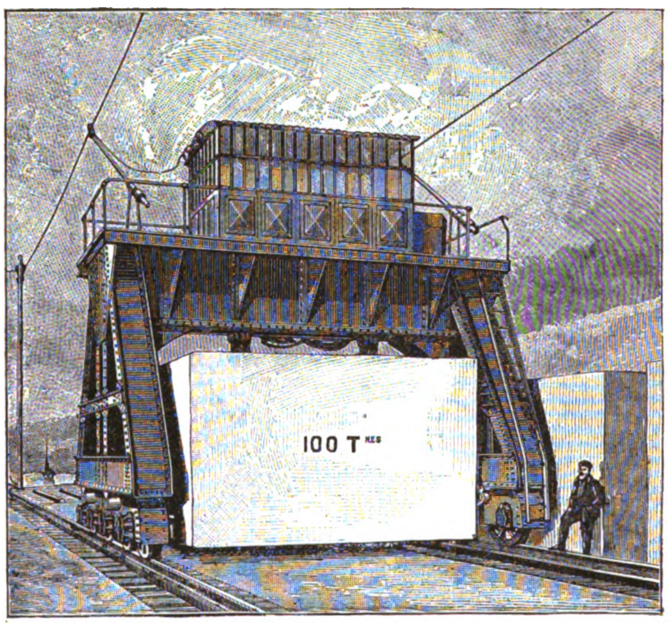
The construction of the traveling crane is well shown in Figs. 1 and 2. It was built of iron, and its only peculiarities arise from the use of the electric current for working it. It consists of two stout standards resting on wheels, balancing levers being used to distribute the weight. These wheels are 2.6 feet in diameter. The standards are spaced 18.7 feet apart, and are connected together at the top by two stiff girders carefully braced together and carrying hydraulic jacks, by means of which the actual lifting is done. In the cabin on top of the girders is placed the electric plant which works the pumps supplying the hydraulic jacks and

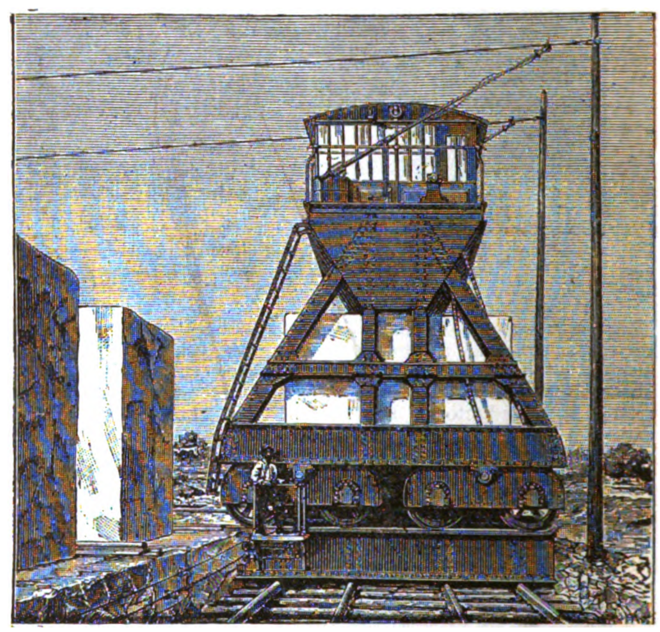
the traversing gear. The collectors, as will be seen, are of the usual overhead tramway type, and are connected with a Gramme motor designed to run at 680 revolutions per minute, which is reduced to 80 at the pump shaft, and to 20 at the traversing shaft, by means of worm gearing. Reversal is effected by making use of a second set of brushes on the commutator. The method of working is as follows: The crane is brought over a block, the hooks are lowered by letting water out of the hydraulic presses, and the crane is then slightly moved forward so that these hooks engage with the eyes moulded into the blocks as already explained. By setting the pumps at work, the block is then raised some nine inches or 12 inches.

The crane is now traversed on to an electric transfer table, which is shown in Fig. 2 with the crane in place on it. The block is then lowered on to this table on which it is conveyed to the loading staithe.

This transfer table is 20 feet long by 15 feet broad, and consists of eight cross girders 1.14 feet deep, resting on four axles, placed in pairs at the ends of the table, and connected together at their ends by girders 2.46 feet deep, on the top of which are fixed the rails for the reception of the crane. Each axle of the truck carries two wheels 1.9 feet in diameter, and, as will be seen, there are four lines of rail, which weigh 108.8 lb. per yard. The motor used for manœuvering this truck is the same type as that belonging to the crane. It runs at 600 revolutions per minute, which is reduced to 5.7 turns per minute at the driving wheels.

The plant has proved remarkably economical. Though probably only 55 per cent. of the power supplied to the dynamo is obtained as useful work, the power is supplied by an economical engine, which would not be the case if each separate crane had been, as is usual, supplied with its own engine and boiler. A single mechanic only is required to look after the three machines, as common laborers are quite capable of working them. The maintenance has been practically nothing. The chief expense is new brushes every three months. The commutators also require turning up about twice a year.





Figs. 1 and 2.—Electric Crane and Transfer Table at Bilbao, Spain.

GAS AND ELECTRICITY AT CLINTON, IA.

Mr. S. M. Highlands, vice-president and general manager of the Clinton, Ia., Gas Light and Coke Co., writes us that he believes his company can demonstrate that the only successful way to operate gas and electric plants in small cities is to place both under one management. Their plant is certainly a fine one, and being protected by a franchise that still has 18 years to run, they do not feel afraid of spending money on it. It comprises 250 arcs of the Thomson-Houston system and 60 of the Wood; 1,000 lights Thomson-Houston alternating and 1,500 Wood. The eight dynamos are driven by two Bass-Corliss engines, one of 800 h. p. and one of 200 h. p., with four tubular boilers of 100 h. p., each built by the Gas Co. The station and stack are of brick. The company, of which Mr. W. J. Young is president, has a capital stock of $200,000.

ON THE SWINBURNE-THOMPSON UNIT OF LIGHT.[1]

BY SILVANUS P. THOMPSON, D.SC., F.R.S.

In the spring of 1892 it was independently proposed by Mr. James Swinburne and by the author of this note, to adopt as a unit of light of standard quality, the light emitted from a unit of area of the positive or crater surface of the electric arc formed between electrodes of pure carbon.

The advantages of this source of standard of illumination over all flame standards hitherto proposed, are so obvious as scarcely to need mention. The advantages over the platinum or Violle unit are also considerable. The carbon arc is much more easily managed, and if a pure carbon is employed, it is much more reliable as a standard than the mass of molten platinum.

The light of the electric arc is emitted, as is well known, chiefly from the end of the positive carbon, very little proceeding from the flame itself, and not much from the negative tip. Except at the edge parts the light of the crater surface, is of uniform lightness at every part if the carbon be pure. The reason of this circumstance is, as pointed out years ago by the writer, that carbon has a fixed temperature of volatilization. The arc cannot be formed at all unless this temperature is reached at least at some portion of the surface; and the temperature cannot be exceeded at any point, simply because the volatilization of the carbon keeps it down.

If an arc has been burning for some time, with a certain current, say six amperes, its crater will have assumed a certain shape or size. If we now increase the current to 12 amperes, the incandescent surface of the positive carbon will be at once increased in proportion, save for a slight discrepancy arising from the marginal effect of the duller parts, and the enlarged crater will settle down to a new shape. (These remarks relate to the steady arc; the phenomenon of the hissing arc being still very obscure). If then by proper shielding there can be cut off all the stray light of uncertain quality emitted by the red hot margin of the crater, that emitted by the negative tip and by the flame, so that only the true crater surface is visible, its whiteness, as so viewed through a hole in a suitable diaphragm, will always be of the same unvarying quality. This was the discovery of Captain Abney, F.R.S. in 1878; and it forms the basis of all the splendid work done by him in conjunction with Major-General Festing, F.R.S., on the photometry of color.

Increasing the current merely increases the size of the crater, but does not alter its intrinsic brilliancy or its color. Increasing the voltage of the arc has no effect on the intrinsic brilliancy or color of the true crater surface. Increasing the length of the arc has no effect on the intrinsic brilliancy or color of the true crater. The amount of light emitted from a square millimetre of crater surface is a fixed quantity, no matter how the current, or the voltage, or the length may be varied; and not only is the total amount of light emitted from a square millimetre constant, but

1. Abstract of a Paper read before the International Electrical Congress, Aug. 21-25, 1893.

its composition is constant. That is to say, the proportion relatively of red waves to blue waves, is the same always, independent of current, voltage, or length of arc.

It was in consequence of the recognition of these physical properties of the true crater surface, that the writer and Mr. Swinburne each made the proposition for the establishment of a new unit to supersede the Violle standard. The author also referred to the recent work of Blondel and of Violle which confirms his views, and also to that of Trotter, who found the light emitted (normally) from a square centimetre of hard carbon to be 70 candles.

Doubtless the imperfections of the photometric methods until recent years, were such that the production of an exact standard of white light was of less importance than is now the case, since photometry has become an art of precision. Professor Ayrton, adopting the periodic principle of photometry lately described by the author, and using a photometric screen of the Lummer-Brodhun pattern, finds no difficulty in measuring light with a precision of one part in 500. Now that such accuracy of measurement is possible, there is the more urgency for adopting a standard which is not only of entire trustworthiness, but is also easily reproduced.

NOTE ON THE VARIATION OF CAPACITY OF INSULATED WIRES WITH TEMPERATURE.[1]

BY HERMANN S. HERING.

WHILE making some tests of insulated wire for the Chicago Electric Company, I determined the capacity, resistance and electrification at various temperatures, and found that there was a decided variation of the capacity with the temperature of the wires. The samples of wire tested were No. 12 and No. 16 B. & S. gauge covered with vulcanized rubber, the patented process of this company, and invented by Mr. H. B. Cobb, of Wilmington, Del. The radial thickness of the insulation was about $\frac{1}{16}$ inch. In two of the samples furnished, the insulation was loose upon the wire, and in three it was tight.

The curves obtained with the two types were distinct and have a definite shape, and show a decided increase of capacity within the usual ranges of temperature met in practice. All the tests were made in the same manner, with the same instruments and with all possible errors eliminated. Readings were taken after the wire had been charged 20 seconds.

It was observed also that the capacity increased slightly with the length of immersion, and that the capacity of the samples whose insulation was loose, not only had a smaller capacity per mile than samples those whose insulation was tight, but also had less variation within the same ranges of temperature. The cause of this increase of capacity with the increase of temperature, is not easily explained unless the expansion and contraction of the insulation acts inwardly as well as outwardly; but yet that does not offer an entire explanation.

FIFTEENTH ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS, PROVIDENCE.

"PHILLIPS WEATHER" is perhaps not known to the United States Weather Bureau, but it has come to be a familiar synonym for a certain class of weather which brought gladness to the hearts of numbers of the friends of the American Electrical Works on Saturday, September 2. For the sake of the uninitiated, "Phillips weather" may be explained to be a beautiful warm sunshiny afternoon preceded by a morning threatening rain, and a night of wet storm. It is a peculiarly pleasing kind of weather, as after a morning of fears and doubts, one appreciates all the more the appearance of the warm sun at noon and the correspondingly pleasant afternoon which follows. Such a day, precisely, was Saturday, Sept. 2, when about one hundred and fifty friends of Messrs. Phillips and Sawyer gathered at the Union Club, Providence, to do honor for the fifteenth time to their generous hosts and partake of their well-known hospitality. To describe in detail all that took place would be in a large measure a repetition of previous accounts. Everyone knows, now-a-days, what to expect at "Phillips' clambake." Everyone goes for a good time, and everyone gets it. For the athletic element in the profession there is always a first-class game of base ball; at least the field is first rate, the bats and balls provided are of the very best quality, some—yes, only some, of the players are first rate players, but we are sorry to report that never yet in our experience, have we seen a first-class UMPIRE. Strange how a man in business may be regarded as of the strictest integrity, who would not stoop at any time to the slightest prevarication,—and yet take that same man, embodying all the virtues, and place him in the field as umpire of a base ball game, as played at the clambake, and he earns for himself a reputation which would do credit to a boodle alderman. The game last Saturday was, we believe, between Providence and Boston,—but Providence did not take care of his own on this particular occasion, or else the umpire was in league with the other side of the house, as, sorry as we are to chronicle it, the writer having survived being on the Boston side, the Bostons won by somewhere in the vicinity of 27 to 12.

The usual football was also on hand, and made sad devastation as in former years, with numerous hats of guests who were foolish enough to wear gear of the kind which they are wont to display on Sundays. Games were also provided for those of a quieter turn of mind, such as shooting at the target, testing lifting power, etc., and in fact there was something for everyone to do, so that a perfect day of blissful recreation from the worries of business was provided.

A new route to the Union Club was chosen this year, a special electric car being chartered for the party, instead of going by one of the river boats as in previous years. This means of transportation has only been opened within the last month, and takes the visitor right to the gates of the ground. The lunch of clams, oysters, salads and the never-failing punch-bowl was heartily partaken of, after which the guests betook themselves to the different sports, gathering together again about two o'clock under the cool shade of the marquée for the toothsome dinner, and succulent clams. After dinner, Mr. C. E. Stump officiated as toastmaker and introduced Mr. Eugene Phillips, who in his usual happy manner, welcomed all who were present. He referred shortly to the hard times through which we are passing, and said that the only way to weather such storms, was to help one another, and he thanked any present kindly for any assistance or lenience which might have been accorded to him. Mr. Mark Day, of the *Providence Journal*, then gave one of his humorous, side-splitting speeches, followed by a few wise words of counsel from Mr. Frank Ridlon. Mr. H. M. Daggett made a capital speech, in proposing the health of the ladies, followed by a few felicitous words from our "old reliable friend," Captain Brophy. Mr. W. S. Key, New England editor of *Electricity*, then electrified the guests by a really remarkably able speech touching on the general depression and encouraged all to strive for success which would surely come to the deserving; and then Mr. Cram, introduced as the silvered-tongued orator from Boston, brought the proceedings to a fitting close by a few well-chosen words.

It is certainly worthy of remark that Messrs. Phillips and Sawyer were the recipients of many congratulations on their undoubted pluck and nerve, in providing such a pleasant entertainment for their friends in these unprecedentedly troublous times, and they are certainly to be credited with even a greater success than in previous years. It was also gratifying to learn that their new factory on the banks of the Pawtucket River, is well forward towards completion, and that they will soon be ready to take advantage of their greatly increased facilities.

After leaving the grounds a number of the guests paid a visit to the station of the Narragansett Electric Lighting Company, where the new large Westinghouse generator was started up for the first time.—

A list of those present will be found below :—

PROVIDENCE.—E. F. Ames, G. H. Thurston, Eugene F. Phillips, Otto Hoff, F. C. Holst, W. C. Woodward, B. J. Linbridge, R. F. Capwell, J. J. McCabe, W. J. Barnes, C. E. Lincoln, John Heathcote, M. O. Happoldt, J. S. Knowles, A. W. Howe, T. R. Howe, M. C. Day, E. A. Smith, W. A. Hathaway, V. A. Thomas, C. P. Chappell, W. N. Munro, W. W. Dempster, Edw. Holmes, E. C. Perkins, A. O. White, C. R. Remington, Jr., F. B. Baker, J. T. Harris, G. H. Olney, W. P. Gannett, B. F. Leavitt, H. S. Cox, J. P. Salisbury, W. J. Thurston, S. L. Thurston, Augustus Wright, J. O. Darling, W. H. Clewley, H. C. Bradford, E. C. Hughes, G. H. Darling, G. A. Steere, J. F. Beck, F. W. Breckinridge, A. P. Crawley, A. H. Hutchins, W. H. Sawyer, G. C. Sims, W. C. Langford.

BOSTON, MASS.—C. B. Burleigh, Joseph Taylor, C. H. Herrick, E. P. Tilton, W. A. Cook, E. A. Chapel, A. D. Blodgett, H. F. Kellogg, C. H. Clark, L. W. Clapp, J. S. Keenan, John Christie, G. B. Norton, J. E. Wilson, F. W. Ainsworth, W. S. Hill, A. C. Shaw, Wm. Brophy, W. E. Geer, W. W. Tanner, H. G. Tuckerman, N. W. Lillie, W. S. Key, R. F. Ross, H. M. French, Frank Ridlon, H. B. Cram, J. H. Studley, Jr., H. F. Woods, C. Z. Bing, H. M. Bullard, T. W. Bevan, C. F. Baker, P. Fahey, M. S. Lewis, L. W. Leedom, Saml. Smith, "Happy" Adams, J. M. Orford, James Bradley.

NEW YORK.—W. F. Osborne, P. C. Ackerman, G. A. Luther, C. E. Stump, Gerritt Smith.

WAKEFIELD, MASS.—L. R. Wallis, F. R. Swain.

NEW BEDFORD, MASS.—G. R. Stetson, W. K. Wagner, C. R. Brice.

REVERE, MASS.—Edward Spinner.

NEWTON UPPER FALLS.—F. E. Babcock.

UXBRIDGE, MASS.—George Wilmot.

LOWELL, MASS.—H. R. Rice, F. J. Boynton, Samuel Young.

PAWTUCKET, R. I.—N. B. Denison, J. H. Andrews, J. A. Jenney, C. T. Seifert, C. E. Smith, J. E. Andrews, W. H. Haskell, C. F. Luther. R. H. Tingley.

NEWARK, N. J.—E. A. Colby.

KANSAS CITY, MO.—Waterman Stone.

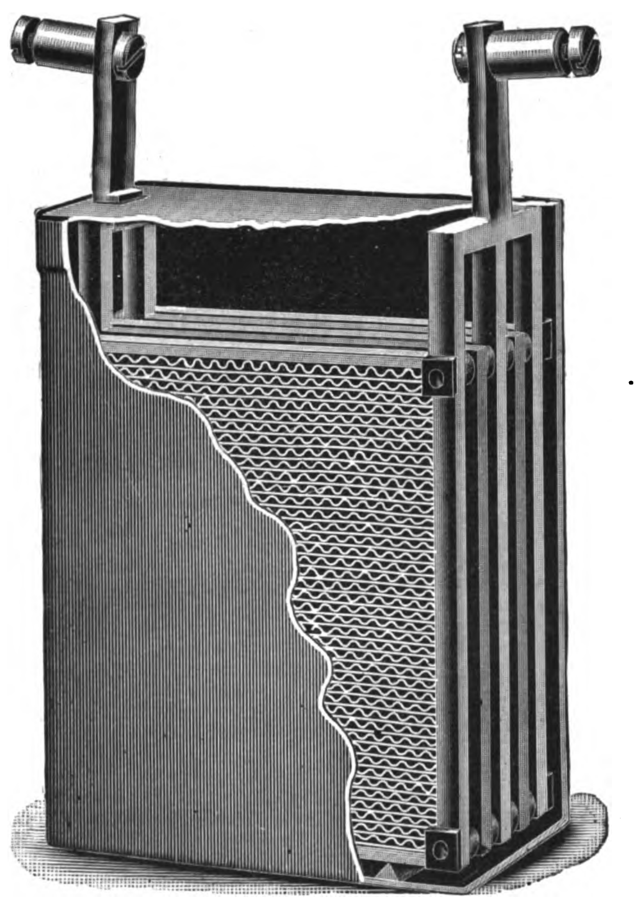
1. Abstract of a Paper read before the International Electrical Congress, Chicago, Aug. 21-25, 1893.

PASCOAG, R. I.—L. J. Crandall.
MONTREAL, P. Q., CAN.—John Carroll.
RIVERPOINT, R. I.—F. E. Walker, H. B. Whitaker.
AUBURN, R. I.—H. H. Sherman.
NEW HAVEN, CONN.—E. N. Clarke, T. P. Lewis, E. B. Baker.
NARAGANSETT PIER, R. I.—S. L. Miller, E. C. Hughes.

G. W. Phillips, Norwich, Conn.; L. G. Savage and H. G. Lockson, Newport, R. I.; William Shaw, Glasgow, Scotland; H. M. Daggett, Jr., Attleboro, Mass.; G. H. Olin and Chas. Sylvester, Fall River, Mass.; E. T. Tremaine, D. K. Carpenter and B. E. Waters. Brockton, Mass.; Waldo A. Learned and Francis Murdock, Newton, Mass.; Frank C. Gibson and W. F. Downes, Canton, Mass.; M. P. Burbank, Whitinsville, Mass.; George Wilmot, Uxbridge, Mass.; C. R. Price, New Bedford, Mass.; Abner Coleman, Taunton, Mass.; H. L. Wilson, Brookline, Mass.; Axel Ekstrom, Lynn, Mass.

THE FRANKLIN COMPANY'S ACCUMULATOR.

WE illustrate below the secondary cell manufactured by the Franklin Electric Company, 136 Liberty street, New York city. It is the invention of F. K. Irving and is of the lead-



THE FRANKLIN ACCUMULATOR.

lead, Planté type. It has a working E. M. F. of about two volts. The plate consists of a marginal frame 6 x 7 inches and ⅜ of an inch thick, filled with alternated straight and corrugated strips of lead. These strips are securely fastened into the frame by a specially-prepared solder, that is not affected by electrolytic action. The expansion due to the formation of peroxide is absorbed by the fluted strips; the corrugations become deeper, folding up on themselves, and locking the peroxide into place so firmly that it cannot be dislodged by the highest rates of charge and discharge. The frame, being of a harder metal than the interior lead filling, serves to stiffen the plates; and it is but slightly affected by the process of forming. No pastes or applied oxides are used, the active material being formed entirely of, and on, the plate itself.

The construction of the plate exposes a very large surface to the action of the solution and current, and permits of high rates of discharge without a drop in potential. In the nine plates of the 150-ampere-hour cell there is 32 square feet of surface, and in the five plates of the 100-ampere-hour cell there is 18 square feet. When assembled into a pile, each plate is separated from its neighbor by three hard-rubber sticks, ¼ of an inch square, placed equally distant from each other on the surface of the plate and so stiffening it that it cannot buckle. The outside separators cover the joints of the lead strips and frame.

The pile is held together by rubber bolts, which pass through the corners of the frames and through holes in the ends of the outside separators. The plates are securely connected by a lead bar having a terminal capable of carrying a current of twice the capacity of the cell. The internal resistance of the Franklin accumulator is about .0001 of an ohm.

The company cannot state from practical experience the length of life of these accumulators, but considers it fair to suppose the cell very durable, as the first ones made about a year ago have been in daily use, and show little or no signs of deterioration. Franklin accumulators having a capacity of 1,000 ampere hours have been manufactured, and are now employed in lighting plants. Two sizes are carried in stock: Type "B" in rubber jar 4⅝ x 7⅜ x 10 inches, weighs complete 24¾ pounds, and has a capacity of 100 ampere hours. Type "C," 150 ampere hours, weighs complete 42¾ pounds, the rubber jar measuring 7⅜ x 7¾ x 10 inches.

Mr. Blizard, secretary of the company, states that the accumulator is covered by broad patents, and that it does not infringe any make of cell in the market. The Franklin accumulator was placed on the market about a year ago, and the letters the company is receiving, together with the duplication of orders, indicates that it is fulfilling all the claims made for it.

REPORTS OF COMPANIES.

THE MATHER ELECTRIC CO.

THE creditors of the Mather Electric Company in Manchester held a meeting on August 31. The proposition was made to pay all the creditors 30 cents on the dollar, to be paid within 30 days. The liabilities of the company are about $195,000, including a mortgage of $45,000 and bank notes of about $90,000. The assets over the mortgage are a trifle over $50,000, which includes machinery, patterns, etc., especially adapted for the kind of work carried on at the factory, but if they were to be closed out it was the opinion they would not bring that amount. The property had been looked over carefully, and the company was of the opinion this was the best offer it could make to the creditors.

President M. S. Chapman said that if these terms could not be accepted, the company would be compelled to assign. In that case the settlement could not be effected within a year and probably not more than 15 cents on a dollar would be realized. If the creditors would accept the proposition, the factory would resume operations as soon as there was a market for the product. It was stated that the action of the creditors at this meeting would not be binding on the other creditors, and if all creditors did not accept the proposition it would be void. The banks are to advance the money for the settlement of the claims and take preferred stock in the company when it resumes operations, for all their claims. A vote was taken on the acceptance or rejection of the proposition and the majority were in favor of accepting it and signed. Others of the creditors did not sign. The company has no book accounts, as the product of the plant was sold through agents, who paid for the goods as soon as delivered.

EQUITABLE MANUFACTURING & ELECTRIC CO.

JUDGMENT against the Equitable Manufacturing and Electric Company of 44 Broadway, of which Cornelius Fellowes was president, has been entered for $29,649, in favor of Wendell Goodwin, on an assigned claim of Eben R. Morse for money loaned.

RECEIVER FOR THE JULIEN ELECTRIC COMPANY.

WILLIAM H. RICKETTS has been appointed receiver of the Julien Electric Company, formally of 120 Broadway, on the application of David E. Austin as receiver of taxes, judgment having been entered in June 1892, against the company for $2,286 personal tax.

THE HAMILTON, ONT., ELECTRIC LIGHT & POWER CO. will hereafter be managed jointly with the Toronto Electric Light Co., some of the stockholders of which are already largely interested in the Hamilton plant.

OBITUARY.

R. D. NUTTALL.

THE death is announced of Mr. R. D. Nuttall, of Allegheny, Pa., well known in the electric railway supply field. He contracted typhoid pneumonia while on a recent business trip to Canada, and died at his home on August 29.

LEGAL NOTES.

THE THEFT OF THE WESTINGHOUSE BLUE PRINTS—IMPORTANT EVIDENCE GIVEN AT PITTSBURGH.

THE action brought by the State of Pennsylvania against the General Electric Company and several individuals, for the theft of blue prints, the property of the Westinghouse Electric Manufacturing Company began at Pittsburgh on Sept. 4 in the Quarter Sessions Court. The title of the case was the Commonwealth vs. William J. Clark, Milton H. Hamilton and Morris W. Mead. Clark is general superintendent of the railway department of the General Electric Company. Hamilton is his private secretary and Mead is the superintendent of the City Bureau of Electricity of Pittsburgh. The other persons who were indicted are: Charles A. Coffin, president; E. W. Rice, general manager, and Walter H. Knight, of the General Electric Company. The latter were, however, not on trial, apparently because the case against them had been abandoned.

The attorneys for the defense were Lyon, McKee and Sanderson, Thomas M. Marshall and John S. Robb, of Pittsburgh; W. S. Hamilton, W. J. Jenks, W. B. Whitney and W. B. Putney, of New York, and E. M. Bentley, of Boston. Dalzell, Scott and Gordon and D. F. Patterson, of Pittsburgh, and Paul Cravath, of New York, assisted the District Attorney in the prosecution. Judge Collier was on the bench.

After the opening of the case by the District Attorney,

H. F. ASHTON was called. He was a draughtsman in the employ of the Westinghouse Company till January, 1893, but from Sept. 1, 1892, was also in the employ of Mead and Clark, to whom he gave copies of sketches, blue prints, etc., of new Westinghouse specialties, as well as prices of labor, material, etc., on certain contracts. He also got for them one of the new stopper lamps on Clark's suggestion. The General Electric Company paid him $150 per month, and Mead got $25 each month out of it. Altogether he received over $2,000 in addition to his expenses. To facilitate operations a regular code was used. He also met Messrs. Hamilton, Fish and Rice and talked with them about inside Westinghouse matters and inventions, answering their questions. In corroboration, 24 letters and 13 telegrams were put in evidence and identified. The code was in the handwriting of Hamilton.

FRANK CARBY testified to being paid for stealing blue prints of all new work, which he gave to either Ashton or Mead.

CHARLES E. CHRISTIAN testified to the same effect.

ALBERT SCHMID, the managing engineer of the Westinghouse Co., testified as to the blue prints spoken of, relating to Niagara Falls work, and plans for World's Fair work, Sacramento, Providence, etc. He said that he visited Lynn early in May, when a Mr. Mack informed him that there were a number of these Westinghouse blue prints in the General Electric Lynn factory.

Counsel for the defense here put in evidence to show that the Westinghouse Co. had been infringing General Electric patents, and that the General Co. had tried to secure proofs of infringement.

WILLIAM J. CLARK, one of the defendants, was called to the witness stand. He said his legal residence was in Connecticut. His business was general agent of the railway department of the General Electric Company. He has been in the employ of the company since July, 1892. He denied all of Ashton's stories as to his purpose in going to Pittsburgh. He met Mead and asked him to help investigate the theft of blue prints from the Lynn factory. He said: "I came to Pittsburgh to discover, if possible, if the Westinghouse Company is using a device of the General Electric Company which was used by the Pleasant Valley Company." He admitted giving Mead $1,200, part of which was for Ashton to prosecute his inquiry. He said this explained all the money transactions.

After Mr. Clark's testimony had been taken, a large amount of evidence was put in as to his previous good character, by public men who had known him from boyhood. Witnesses were also called to prove Ashton's bad character.

The jury then took the case, but after being out a day returned without being able to agree in their verdict. It is said that on the first ballot the jury stood seven to five for acquittal, and that during 100 subsequent ballots they stood six to six.

The accused will, it is said, be tried again.

Herbert F. Ashton, the principal witness for the prosecution, has been arrested. He was taken before Squire McMasters and gave bail for court. The allegations are that he stole blue prints, tracings, etc., from the Westinghouse Electric and Manufacturing Company, as he admitted on the witness stand in the conspiracy case. He is charged with larceny by Edward S. Carpenter, who made the information.

AN INJUNCTION AGAINST LAMP CONSUMERS.

JUDGE SWAN in the U. S. Circuit Court at Detroit, Mich., has issued a preliminary injunction on the motion of the Detroit Edison Illuminating Company restraining the Detroit Confectionery and Fruit Tablet Company and the Huyett & Smith Manufacturing Company from using incandescent lamps which infringe the Edison patents.

SUIT TO ENJOIN THE PACKARD LAMP.

JUDGE RICKS, in the U. S. Circuit Court, at Cleveland, O., has rendered a decision in the suit begun by the Edison Electric Light Company against the Packard Electric Company, of Warren, O. The contest was over the alleged infringement by the Packard Company of the Edison lamp patent. The suit was commenced for damages, but a request for an injunction to prevent further use of the alleged infringement was included. The defense of the Packard Company was that they have not been manufacturing the lamps and that the suit was not properly brought. They claim that the part of the factory at Warren in which the lamps are made was leased from them by the New York and Ohio Company, a Virginia corporation, and that the New York and Ohio Company should do the accounting for the manufacture of the lamps if an accounting is to be had. The counsel for the Edison Company engaged were Frederick P. Fish, of New York, William K. Bolton and H. M. Bates; and for the Packard Company, Judge E. B. Taylor, of Warren; Hon. A. P. Smith, of New York; and Virgil P. Kline, of Cleveland.

On Wednesday, Sept. 6, Judge Ricks rendered an opinion refusing to enjoin the Packard Electric Company, but granting an injunction against J. W. and W. D. Packard, who are officers of both the Packard Electric Company and the New York and Ohio Company, with leave to the Edison Company to renew their application for an injunction against the Packard Company.

TELEPHONE PATENT SUITS IN CHICAGO.

A SPECIAL dispatch from Chicago of Sept. 5 says: The American Bell Telephone Company has commenced chancery proceedings in the United States Court against several Chicago manufacturers and operators of electrical telephones. The complainant company bases its action upon the Alexander Graham Bell telephone patent of Jan. 30, 1877. The defendants in the several suits are: William L. Adams, Western Telephone Construction Company, Electric Appliance Company and D'Unger Electric Telephone Manufacturing Company and the Brown Telephone and Telegraph Company.

A decree is asked to recover on profits obtained by the sale of such instruments, also damages, as the Court may direct, and a permanent injunction.

LETTERS TO THE EDITOR.

"DISTRIBUTING REMEDIES" IN OCEAN TELEPHONY.

I HAVE only just had time to read, in the ENGINEER of August 30th, the paper of Prof. S. P. Thompson, on the above subject. It is one in which I have taken some interest, and on which I began to work about a dozen years ago. Reference to the patent records will show that in 1881 I proposed and patented a form of cable similar in general plan to that now proposed by Prof. Thompson, and I believe entirely free from any objection on the score of difficulty of manufacture or of laying. Circumstances have prevented my following the subject since that time, but I have never given up the belief that I was then on the right track, and that important results would have followed had I been able to induce anyone to risk the necessary capital in experiments on a practical scale. This I could not do, and the matter has lain dormant ever since. I do not claim that I anticipated all that Prof. Thompson now proposes. Inductive shunts were not heard of at that date. But the general idea of a "distributed remedy" is clearly shown in my patent, and I did not need to shift any of the responsibility of successful manufacture upon the "cable engineer," as the form I proposed could be made and laid without any difficulty with existing machinery. My American patent was assigned to the American Bell Telephone Company, and the English patent is No. 4,058, of 1881, and is dated September 20th of that year. I think it due to myself to make this mention of my work, in view of Prof. Thompson's statement that a "distributed remedy" had never before been proposed. It was proposed, but was so far in advance of the times that, like Goebel's lamp, it was quite lost sight of again before the time was ripe for it, if indeed it is so yet. The doubts with which Prof. Thompson's proposal is received seem to indicate some uncertainty on this point even now.

J. B. HENCK, JR.

BROOKLYN, N. Y., Sept. 5, 1893.

MR. VICTOR M. BERTHOLD, who is well known in electrical circles in Boston, has become editor-in-chief of the *New England Courier* and the *Providence Courier*.

PERSONAL.

MR. G. P. LOW, president of the California Electrical Society, and one of the ablest electricians on the Pacific Slope, has been making an eastward trip after attending the Electrical Congress, in which he took a great interest. Mr. Low is making a strenuous fight in California for better electrical construction, and by personal influence, official authority and the use of a vigorous pen is doing splendid work.

MR. JOHN CASSIDY, a veteran telegrapher and telephonist, now prominently connected with telephone and electric light interests in the Sandwich Islands, has been attending the World's Fair and visiting his old friends in New York. Mr. Cassidy has had an extensive share in the rapid electrical development of Hawaii, and speaks hopefully of the next step—electric traction.

MR. HENRY E. HAWLEY, the general manager of the Hudson River Telephone Co., is the subject of a very appreciative sketch in the Albany, N. Y., *Times-Union*. He is the son-in-law of the late A. B. Uline, from whom he derived his first enthusiasm for the telephone, and of whom he is a most worthy successor. Mr. Hawley is only 31 years of age.

PROF. W. E. AYRTON and Miss Ayrton passed through New York last week from Chicago, and left for England by the "Germanic" on Wednesday. They have spent several weeks in America, making hosts of friends, for many of whom the acquaintance has been altogether too short.

MR. N. D. WEBSTER, who has been the advertising solicitor for the *Electrical World*, has resigned his position. He will connect himself with the *Street Railway Gazette*, and will represent that journal in a large territory. We understand that Messrs. Perry, editor, and Clifford, business manager, have also left the *World*.

MR. G. U. G. HOLMAN, late of the Mather Electric Company, has joined the forces of the Vulcan Steam Boiler Works, of Twenty-fourth street, near Third avenue, Brooklyn, builders of all classes of boilers.

MR. W. MCLEMONT has become general manager of the Dubuque Light & Traction Co., vice Mr. W. T. Griffith resigned. He will have Mr. H. A. Douglass as his assistant.

SOCIETY AND CLUB NOTES.

BRANCHES PROPOSED OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

A MEETING was held at the World's Fair headquarters of the Institute on September 2, to discuss the formation of branches or chapters in different parts of the country. Mr. E. Caldwell, presided, and Mr. H. A. Foster acted as secretary. Remarks were made by Secretary Pope, N. S. Keith, Lieut. Rodman, C. C. Haskins, W. H. Preece, B. J. Arnold, G. M. Phelps, R. H. Pierce and others, and the general sentiment was found to be favorable to the institution of something of the kind. In Chicago, the Institute has been offered the use of a room at the Armour Institute, and Prof. Stine, of the Institute promised the use of other facilities. Mr. Keith spoke of the prospect of similar work in San Francisco.

The chairman then appointed Messrs. H. A. Foster, B. J. Arnold and R. H. Pierce a committee to follow the matter up.

OLD TIMERS.

THE OLD TIME TELEGRAPHERS ASSOCIATION and the U. S. Military Telegraphers will hold their thirteenth reunion at Chicago, September 12, 13 and 14, with headquarters at the Great Northwest Hotel.

ELECTRO-THERAPEUTISTS.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION will hold its third annual meeting in Chicago, September 12, 13 and 14, at Apollo Hall, when a very long and interesting programme will be presented.

CANADIAN ELECTRICAL ASSOCIATION.

THE third annual convention of the Canadian Electrical Association will be held at the Industrial Exhibition Buildings, Toronto, on September 12, 13 and 14, when the papers already mentioned in these columns will be read and discussed.

PROF. E. HOSPITALIER, the editor of *L'Industrie Electrique*, and one of the official French delegates to the Electrical Congress, returned to France on "La Champagne" last Saturday after a prolonged stay in this country, during which he saw all that is latest and best, as well as much that is worst, in American work and practice.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUGUST 22, 1893.

Alarms and Signals:—

Electric Signal Device, O. Schwennicke, Berlin, Germany, 503,709. Filed March 30, 1893.

An apparatus adapted to give a variety of signals by means of a rotating toothed wheel acting with an adjustable electrically connected lever.

Block Signal Indicating Mechanism, J. H. Frischen, Berlin, Germany, 503,718. Filed May 1, 1893.

An electric block signal system especially adapted to single track lines of steam railway.

Conductors, Conduits, and Insulators:—

Electric Cable, M. G. Kellogg, Chicago, Ill., 503,604. Filed Nov. 15, 1890.

Consists of individual wires laid up in cable form with their insulations in contact as usual and with other wires occupying the triangular spaces between them.

Wire Coupling, W. E. Banta, Springfield, O., 503,712. Filed Oct. 5, 1892.

Employs a gripping connector, encircling the overlapping ends of the wires to be joined and divided into connected portions, with means to swell the size of the joint at the place between said portions of the connector and effect the gripping engagement.

Section Insulator, L. McCarthy, Boston, Mass., 503,749. Filed April 15, 1893.

Insulator for Electric Wires, W. D. Trimble, Hanesville, Md., 503,778. Filed April 14, 1893.

An insulator consisting of two semi-cylindrical portions longitudinally grooved on their flat faces and held together by a sleeve.

Electrical Conduit for Buildings, J. J. Powers and R. Van Buren, Brooklyn, N. Y., 503,878. Filed April 27, 1893.

An interior conduit made of sections of baked clay.

Distribution:—

System of Electrical Distribution, O. B. Shallenberger, Rochester, Pa., 503,621. Filed March 3, 1887.

Claim 1 follows:

In a system of electrical distribution, the combination with a circuit supplied with alternating electric currents, of a group of converters having a ratio of conversion of one to one and having their primiary coils connected in multiple arc and their secondary coils connected in series.

System of Electrical Conversion and Distribution, W. Stanley, Jr., Great Barrington, Mass., 503,622. Filed March 28, 1887.

Employs an auto-converter, a feeding circuit including more or less of its coils, and two or more derived circuits having their terminals connected across more or less of said coils.

Dynamos and Motors:—

Starting Device for Electric Motors, A. D. Adams, St. Paul, Minn., 503,568. Filed Oct. 19, 1891.

Employs a series of contacts with intermediate resistances, and stops engaging the contact arm and preventing it from reverse movement to break the circuit at the first contact or to close it at the last.

Dynamo Electric Machine or Motor, C. S. Bradley, Avon, N. Y., 503,574. Filed April 15, 1893.

Employs a plurality of armature windings on the same core and electrical connections between the base of the machine and an intermediate point of the windings and circuit terminals.

Self-Exciting Alternate-Current Generator, P. Diehl, Elizabeth, N J., 503,581. Filed April 11, 1887.

Employs an armature with two circuits revolving in the same field and delivering alternating and continuous currents respectively.

Apparatus for Controlling Electric Motors, S. S. Wheeler, New York, N. Y., 503,690. Filed June 6, 1892.

Employs a switch whose handle may be advanced or retracted through its complete phase and whose switching mechanism will follow the handle at a relatively slow rate of speed.

Regulating Apparatus for Electric Motors, C. H. Richardson, Philadelphia, Pa., 503,750. Filed April 27, 1893.

Employs a motor mechanically driving a generator; a switch mechanism in the motor circuit; another switch mechanism in the generator circuit, and a lever by which both switches are simultaneously operated.

Lamps and Appurtenances:—

Incandescent Electric Lamp, E. E. Cary, Boston, Mass., and W. E. Nickerson, Cambridge, Mass., 503,650. Filed April 3, 1893.

The glass bulb is provided with a shoulder between the air tight sealing plug and the vacuum chamber against which rests a loosely fitting disc holding the fusible cement in place.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 503,669. Filed April 7, 1893.

A lamp in which the vacuum is maintained by a plug of fusible cement and provided with a device for preventing the heat of the filament from softening the cement.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 503,670. Filed July 19, 1893.

Employs a bulb, the neck of which is closed air tight and the leading in wires sealed and supported by a plug of fusible cement.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 503,671. Filed July 17, 1893.

Similar to 503,670.

A system of controlling individual lamps on a circuit from any number of distant points.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 503,770. Filed July 3, 1893.

Employs a section of fusible metal in circuit with the filament to prevent generation of excessive heat.

Electric Lighting System, L. Vialet-Chabrand, Ciotat, France, 503,688. Filed April 2, 1892.

Electric Arc Lamp, W. W. Millard, Fenton, Mich., 503,799. Filed April 3 1893.

Employs a cross-head on the movable carbon rod, a detachable connection between the rod and the cross-head and two carbon-sockets on the latter.

Measurement:—

Electric Measuring Apparatus for Alternate Currents, S. Evershed, London, England, 503,589. Filed Dec. 22, 1891.

Employs a working coil about which is a shunt impedence coil to compensate for the errors due to alternating current.

Electric Meter, F. L. Gregory, Niagara Falls, N. Y., 503,595. Filed May 14, 1893.

An amperemeter employing a time piece, a current timing mechanism, other mechanism for connecting the timing apparatus with the time piece,

and electrically actuated means for throwing the connecting mechanism into or out of action.

Electric Meter, A. Reckenzaun, London, England, 503,805. Filed Nov. 26, 1892.

Has for its object to obtain a record of measurement without the use of ordinary clock work, pendulums or balance wheels.

Metallurgical :—

Method of Producing Aluminum, J. B. Hall, Wheeling, W. V., 503,929. Filed August 6, 1892.

Employs a fused bath composed of aluminum chloride, sodium chloride and lithium chloride.

Miscellaneous :—

Electric Belt, A. Stephenson and J. Backstrom, Stromsburg, Neb., 503,811. Filed Feb. 23, 1893.

Combined Gas and Electric Light Fixture, J. A. O'Neill, Boston, Mass., 503,912. Filed Oct. 29, 1892.

Railways and Appliances :—

Electric Railway Trolley Switch, J. H. Allison, Elkhart, Ind., 503,570. Filed March 3, 1893.

Contact for Conduit Electric Railways, A. Wörner, Buda-Pesth, Austria-Hungary, 503,710. Filed May 18, 1893.

Provides a guard to protect the conductors from injury by preventing rubbing or friction against the walls or rails of the slot.

Electrical Contact Device, J. K. Pritchard, Providence, R. I., 503,775. Filed March 20, 1893.

Employs trolley wheels mounted in pairs on pivoted plates and springs exerting a strain on the plates.

Switches and Cut-Outs :—

Switch for Electric Lights, E. Blasser, Boston, Mass., 503,698. Filed Aug. 3, 1892.

Lightning Arrester, W. Le R. Emmet, Chicago, Ill., 503,758. Filed July 11, 1892.

A multiple fuse lightning arrester affording several paths of discharge and providing means by which the circuit may resume its normal electric condition.

Electrical Cut-Out, L. B. Matson, Elmira, N. Y., 503,867. Filed Jan. 19, 1893.

A device for throwing the current of a street circuit around a loop for temporary lighting.

Telegraphs :—

Telegraphy, S. D. Field, Yonkers, N. Y., 503,590. Filed Jan. 16, 1893.

Employs transmitting and receiving instruments having practically no self-induction and therefore offering no retardation to the transmission of current.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

WIRING THE FERRIS WHEEL WITH OKONITE.

The greatest mechanical and engineering wonder at the World's Fair is the huge Ferris wheel in the Midway Plaisance. It rises 270 feet into the air and carries 36 cars each as big as an ordinary passenger coach. Its axis is a shaft 45 feet long, 32 inches in diameter, weighing 70 tons. A Western Electric plant furnishes current to some 3,000 incandescent lamps with which its circumference and frame are bespangled at night, and in order to make sure that the circuits should be sound and true, Okonite wire was exclusively used, the contract being given to the Central Electric Company, of Chicago, for miles and miles of that famous brand. The wheel and plant work beautifully, and at night the wheel looks like a near view of a beautiful solar system set edgewise.

THE WADDELL-ENTZ COMPANY.

Mr. J. Holt Gates, Western Manager of the Waddell-Entz Company, reports that they are placing a large motor in the new Illinois Central Depot, Chicago, to operate a 60-inch Sturtevant fan, and also a large number of motors for a mining and transmission plant in Michigan. Despite the dull times, considerable work is being done.

The following agencies have been established to represent the Western Department of the Waddell-Entz Company : At St. Louis, Owen Ford, formerly of the Denver office of the General Electric Company ; at Cincinnati, Messrs. Price, Gaither & Price, Perin Building ; at Grand Rapids, the Peninsular Electric and Engineering Company, Michigan Trust Building. These agents will operate in the territory adjacent to their offices.

WISE TRAVEL AND TRAVEL WISE.

The New York Central and Hudson River Railroad Company has issued the fourth book of the Four-Track Series ; or, "Health and Pleasure on America's Greatest Railroad," a publication which is not only one of the handsomest works of the kind ever gotten out, but is full of information for the summer tourist who wants to go somewhere and does not know how to take the initial trip. This book of over 350 pages tells the traveler about all the places that he is most anxious to see, shows him how they look, and explains the best way to reach them. There are 300 pen and ink sketches and wood engravings, and the letter-press is furnished on the principle so that he that runs may read. The wonderfully varied scenery of New York State is not alone described and portrayed, but the far West, and even "A Trip to Japan" are included. Beaconsfield's maxim, "Travel is the greatest source of true wisdom," is the motto of the book. A copy will be sent free to any address upon receipt of five two-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

GENERAL ELECTRIC RAILWAY MOTORS FOR BROOKLYN, N. Y.

The General Electric Company has just closed a contract with the Brooklyn Heights Railroad Company, of Brooklyn, for two hundred electric car equipments, comprising the new "G. E. 800" motor and the latest type of series parallel controller. This contract was secured in the face of considerable competition.

NEW YORK NOTES.

The Abendroth & Root Manufacturing Co., 28 Cliff street is issuing some very effective literature of a brief and pithy nature as to the merits of its improved Root boiler, and containing views of its fine plant at the World's Fair. Root boilers are very much in demand for quick steaming and dry steam.

The New York Insulated Wire Co., reports itself to be feeling expansively cheerful under the speedy return of good times. The resumption of building is loading it with large orders.

Mr. A. B. Laurence, 1a Platt street and 225 Pearl street, is circulating a strong testimonial from the Perry, N. Y., Electric Light Co., as to the excellence of the Shultz patent leather pulley covering.

The Interior Conduit and Insulation Co., notify us that they are pushing infringement suits against contractors and owners installing Vulca ducts.

WESTERN NOTES.

The Electric Appliance Company are showing the trade a new iron box bell that has a number of small improvements over the old form of bell, in an automatic set screw on the adjustment ; an armature spring that is attached to the soft iron armature without rivets ; and a frame made entirely of soft stamped iron. It is known as the "Acme" iron box bell.

Mr. W. H. McKinlock wishes to announce that he has taken offices in rooms 319-320 Manhattan Building, Chicago, where he will be glad to see his friends and receive any communications from those who wish to reach him by correspondence.

St. Clair, Mich., is putting in a municipal plant under plans designed by Jesse M. Smith, of Detroit. The plant is of the Western electric system of arcs and the Westinghouse alternating, and comprises 40 arcs and 1,750 incandescent, with 12 miles of circuit. The plant is run in connection with the city water works, but has a separate Dick & Church compound engine and Manning boiler. Mr. A. S. Hatch is the city electrician, and Hatch Bros. have the wiring in charge.

St. Paul, Minn.—An instance of the flexibility of electric traction is being given at St. Paul, where the dull times have necessitated a reduction in the service of the Twin City Rapid Transit Co. Cars have been taken off, but in every instance the speed has been materially increased so that the public is the gainer and is much pleased. This could hardly be done satisfactorily, if at all, with horses and cables.

The South-Eastern Tariff Association has raised the rates 75 per cent. on buildings which have electric light wires running into them either for lighting purposes or as a motive power. This should lead to an overhauling of bad work, so that the higher standard will again bring the rates down. Bad work punishes itself.

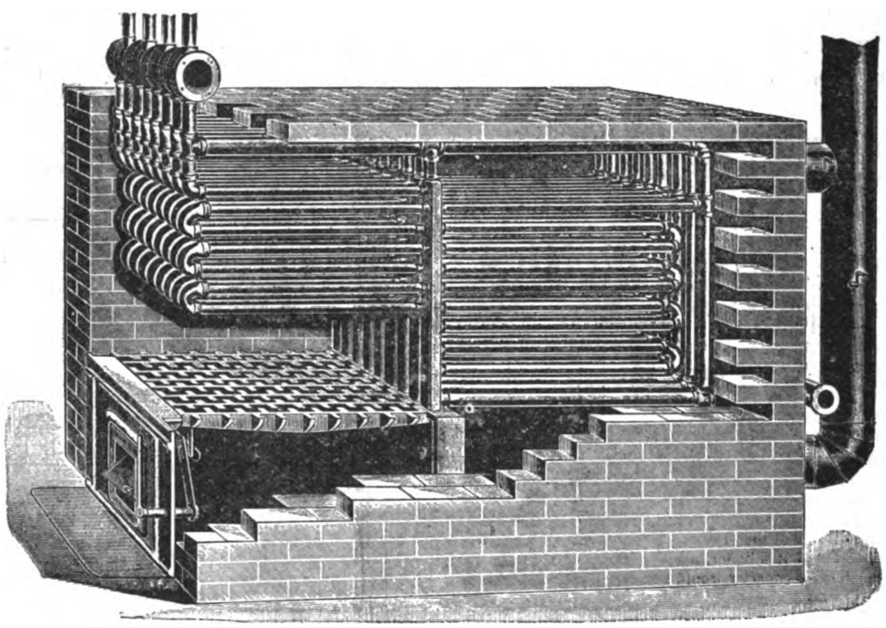
The Turf Villa Summer Garden, Philadelphia, Pa., after looking at a number of different makes of engines, gave an order for a 35 h. p. Ball engine to J. W. Parker & Co., Philadelphia representatives of the Ball Engine Co.

Mr. H. M. Whitney has resigned the presidency of the West End Street Railroad Company, of Boston, in order to devote his time to the Nova Scotian coal properties in which he has of late become largely interested.

THE "ELECTRIC" BOILER.

We illustrate herewith a perspective section of the "Electric" boiler made by the Electric Boiler Co., of 23 Stillson street, Rochester, N. Y. It is a horizontal tube boiler composed of heavy iron stand pipes cylindrical in form and capable of withstanding any pressure or strain that can come upon them. Into these stand pipes, wrought steel tubes are screwed with right and left hand threads, with return bends at the opposite ends. The bends are so arranged that they bring the top pipe of one pair opposite the bottom pipe of the opposite pair in such a manner as to secure to some extent a continuous circulation of water. Each stand pipe with its complement of tubes forms a section. From the bottom of the rear side of the pipe a tube is extended outside of the brickwork or casing which connects into a flange tee or cross. These tees and crosses are bolted together, forming a header or drum to which the return pipes are connected. The top tubes, front and rear, are carried upward and connected with an eduction pipe as is also a tube from the top end of the stand pipe. These eduction pipes form the top of the combustion chamber and are extended out through the top of boiler covering, near the front end, and connected with a flange tee or cross. These tees and crosses are also bolted together forming the flow header from which the flow pipes are connected.

By this arrangement each section becomes, for all intents and purposes, a separate boiler with an action and circulation peculiarly its own. By varying the length of the tubes and the number of sections, all sizes of boilers can be furnished and in any shape that may be desired in length and width. This feature is of great importance to consumers and, it is claimed, has never been accomplished before. By the arrangement of sections and method of connecting each independently of the other into the flow and return headers, it admits of repairs being made in case of accident, by any ordinary steam fitter, without disturbing the rest of the boiler, as each section can be disconnected and removed with the greatest ease, repaired and replaced, or an entirely new section may be put in without losing the use of the rest of the boiler except for such time as the section is being disconnected and reconnected.



The "Electric" Boiler.

The tubes are arranged in a partially staggered form so as to present the greatest possible surface to the action of the heat, and at the same time produce as little friction as possible in the smoke passage. These tubes project over the fire and the vertical header forming a bridge, the travel of the flame is as indicated by the full arrows, the circulation of water being shown by the dotted arrows. R is the return main and S is the flow pipe. It is claimed that this may be used as a steam or hot water boiler. A section or two may be used independently on hot water circulation, while the other part is used as a steam boiler. The heat passes upward between the vertical rows of staggered tubes on the front side of the stand pipes, passes over between their top ends and the eduction pipes, and between the short tubes connecting them into the rear combustion chamber, downward between the rows of staggered tubes at the rear of the stand pipes and thence into the smoke pipe, leaving the boiler at the point where the water is the coldest, and thus parting with the greatest possible amount of heat in its downward passage.

TROLLEY CANAL PROPULSION.

It is stated that experiments are beginning with trolley propulsion on the Erie Canal. The Westinghouse Co. is erecting a trolley on a section from Rochester to Westport, N. Y., and the General Electric Co. on a three-mile section from Albany, N. Y., West. The experiments aim at a maximum speed of five miles per hour.

WESTERN NOTES.

The Electric Appliance Company are meeting with considerable success with their new "Acme" lamp socket. It has a number of small improvements in the details of construction which are meeting with the approval of the trade and winning some very large sales. The recent cool weather has interfered somewhat with the fan motor business, but the Electric Appliance Company report that they have only a few left of their large stock of fan motors and expect by making some special inducements in price to close them out.

NEW YORK NOTES.

The R. Thomas & Son Co. are well known as among the largest producers of porcelain for electrical work. They have recently established a New York office at 136 Liberty street and appointed Mr. Chas. E. Chapin, manager. The company carry in stock at New York a full line of porcelain insulators and cleats, also porcelain tubes so that orders can be promptly filled. Eastern inventors desiring quotations on new or special designs in porcelain will find the Thomas New York office a convenience, and Mr. Chapin is commissioned with prices to catch the business.

Mr. C. Newton, of Spaulding & Metcalfe, 55 North Seventh street, Philadelphia, was a caller in New York last week, and reported a much better prospect of business. The electrical department of this young and growing house has found plenty of work in these dull times, and Mr. Newton is almost rushed enough to satisfy even his ceaseless activity. The merits of Campbell wire are pretty well known, but Mr. Newton's account of its new virtues as a mule saver is really worth hearing.

SOUTHERN NOTES.

The Southern Electrical Manufacturing and Supply Company, Limited, of Baronne street, New Orleans, is the subject of a very appreciative sketch in the New Orleans *Times-Democrat.* It handles the products of the General Electric, Fort Wayne and other companies, and does a large amount of contruction, manufacture and repair. Mr. E. L. Bemiss, of whom a portrait is given, is the president and Mr. E. P. McKinney, the electrical engineer. The company has in hand a large electric railway contract in New Orleans.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

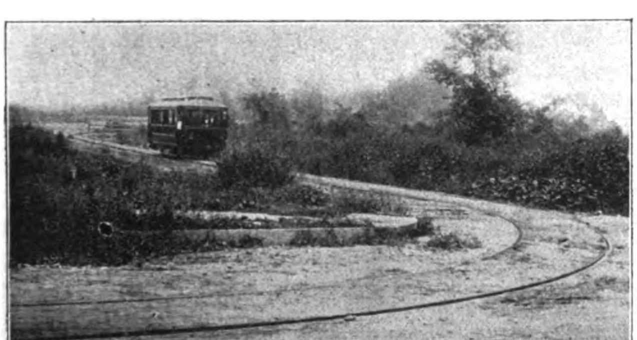
Vol. XVI. SEPTEMBER 20, 1893. No. 281.

THE ELIESON STORAGE BATTERY SYSTEM ON THE NORTH MT. VERNON ELECTRIC RAILWAY.

C. P. Elieson.

One of the most interesting electric railways, certainly in this part of this country, has been in operation in the quiet little town of Mount Vernon, N. Y., since July 31. The road is unique in more than one respect. In the first place the track, two miles long, is laid directly on the surface of a country road, with no attempt at grading and does not contain 25 feet on a level from one end to the other, while the curves are more numerous then the stretches. It may be interesting to follow the course from start to finish, remembering that, in addition to its other peculiarities, the rails are not aligned very well and that the track is usually partly covered with either dust or mud according to the state of the weather.

Starting from the New York and New Haven Railroad station, the eastern terminus, there is first a down grade of 3 per cent. (the word "grade" being used by courtesy) for about 400 yards, at the end of which is a curve at right angles with a 37-foot radius on an up grade of $3\frac{1}{2}$ per cent.; this grade continues for the length of a city block, curves again at right angles, with the same radius as before, continues for about 60 yards in a straight line and makes another curve with a radius of 60 feet. The wheel base of the car, by the way, is $6\frac{1}{2}$ feet. From this point the road is straight for about half a mile and has an upward grade varying from 3 to 4 per cent. Passing the top of this hill the road takes a dip of 200 yards on a



Two 37 Foot Curves.

$6\frac{1}{2}$ per cent. grade and immediately starts up again at 4 per cent. around a curve of 45 feet radius; up a short stretch of straight track and another curve with a 3 per cent. grade; then another stretch where the track is more nearly level, but not so much so as to prevent the car from coasting along it on the return trips; two more curves, right and left, the second on a short, sharp grade, and, finally, a longer straight bit of road on which the grade ranges from 1 to 3 per cent.

The rolling stock consists at present of one car, for the road is an experimental one, so far as the Mount Vernon company and town authorities are concerned, though the system upon which it is run has passed considerably beyond

Ascending a Long Grade.

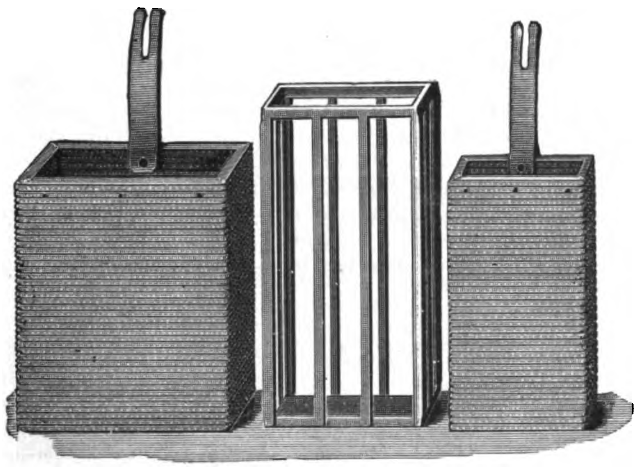
the experimental stage, and its inventor, Mr. C. P. Elieson, purposely selected a route possessing as many disadvantageous points as possible to show just what his accumulators could do if the occasion demanded.

It will be well to pause here to describe in detail the type of cell with which the car is equipped. It was invented, as has been said, by Mr. C. P. Elieson, and is built wholly on the Planté principle. Thus, while containing but two electrodes, a large surface is exposed for the storage of electrical energy. The construction will be readily understood by reference to the illustrations, Figs. 1, 2, 3 and 4, showing respectively the negative electrode, the separator, the positive electrode and an electrode partly broken away to show the arrangement of the parts. The positive electrode is inserted in the skeleton box or separator, and the whole is then placed in the negative electrode, and the hard rubber box enclosing the whole is provided with a rim extending one inch from the bottom, upon which the negative electrode rests so as to prevent any possible short-circuiting from the agglommeration of oxide dropping at the bottom. The electrodes are built up of a series of corrugated and perforated envelopes of thin lead, one on top of the other, and each corrugation is so arranged as to run across, or at an angle with, the corrugation of the next envelope; in practice, nine of such envelopes compose one electrode. The positive electrode, 5 x $3\frac{1}{4}$ x 8 inches, has 4,000 square inches of exposed surface; the negative measures $6\frac{1}{2}$ x $4\frac{1}{2}$ x 8 inches. The lugs on each electrode run directly to the bottom and are burnt through and through in order to secure a perfect metallic connection

with each envelope. The weight of the two electrodes is 12½ pounds, and the complete cell weighs 23 pounds including the box and electrolyte.

The formation process is carried out in the usual way, partly chemically and finished electrically.

The storage capacity of this cell is about 100 ampere hours, but the formation can be stopped at 60 or 80 ampere



FIGS. 1, 2 AND 3.

hours, as it soon increases in its capacity while in actual work. Buckling in this form of accumulator is totally obviated, at least during the first year of work, as there is ample space between the corrugations to allow for the molecular increase of oxide, but the total filling up between the several envelopes cannot, it is said, take place before two years of constant work. Although at the end of that time this accumulator attains its highest degree of capacity, it is advisable in traction work to renew the positive electrode after 12 months, during which time, it is claimed, no attention whatever is required beyond replacing the electrolyte lost by evaporation.

The equipment of the car consists, then, of 200 of these cells normally connected in parallel but so controlled from the starting box that, on steep grades, or other places where more power is needed, they may be placed in series; and one 7 h. p. Thomson-Houston motor wound for 250 volts and 20 amperes. A Stephenson truck formerly used on the Fourth avenue road in this city, with two Thomson-Houston motors, was secured and one motor discarded entirely. The other was then rewound to suit the present conditions and is doing the work alone. As a matter of fact in ascending the 6½ per cent grade not less than 15 mechanical horse-power is frequently developed. The accumulators are placed under the seats and beneath the body of the car and are never removed for charging. Instead, at the end of each six miles run, the car enters the power house and the batteries are charged for about ten minutes, when work is resumed for another six miles.

The diagram, Fig. 5, shows the construction of the controlling switch. In the position shown, all the circuits are open. On revolving the handle to the right the batteries are connected in parallel to the motor through resistance which is all cut out gradually in the first quarter revolution. The circuit is then momentarily broken and the batteries are connected in series to the motor through the same resistance as before, which is again cut out during the second quarter revolution. A stop prevents the connecting bars from revolving further, while lugs on the handle which can only pass through corresponding notches on the lid prevent it from being withdrawn except when the current is quite cut off from the motor.

On the regular trips the car makes from 4 to 7 miles an hour on up grades while on the comparatively level parts of the road a speed of 12 miles an hour is attained, and about 44 miles a day are covered. On one of the regular trips recently some readings were taken on voltmeter and ammeter, both Weston instruments, that are exceedingly interesting. They are shown in the following table:

Remarks.	Grade %.	Amperes.	Volts.	Battery Connections.
Start....................	—3	16	180	Parallel.
Curve....................	3½	30	180	"
Straight track...........	3½	25	176	"
Curve....................	3½	40	172	"
Long, straight track......	3 to 4½	40	170	"
" " "	"	38	170	"
" " "	"	39	168	"
" " "	"	39½	168	"
" " "	"	36	170	"
Start from state of rest...	4½	80[1]	170	"
Long, straight track......	3 to 4½	33	170	"
" " "	"	42	166	"
" " "	"	30	315	Series.
Curve....................	4	36	168	Parallel.
"	3½	34	290	Series.
Straight track...........	2½	28	170	Parallel.
Long hill on back trip....	6½	40	280	Series.
Readings about every half minute.	"	45	250	"
	"	50	230	"
	"	50	230	"
	"	55	230	"
	"	55	230	"
	"	45	250	"
	"	40	280	"

1. Momentary swing of needle. Immediately dropped to 33.

The power house, consisting of two little rooms connecting with the car barn, contains a 50 h. p. boiler and

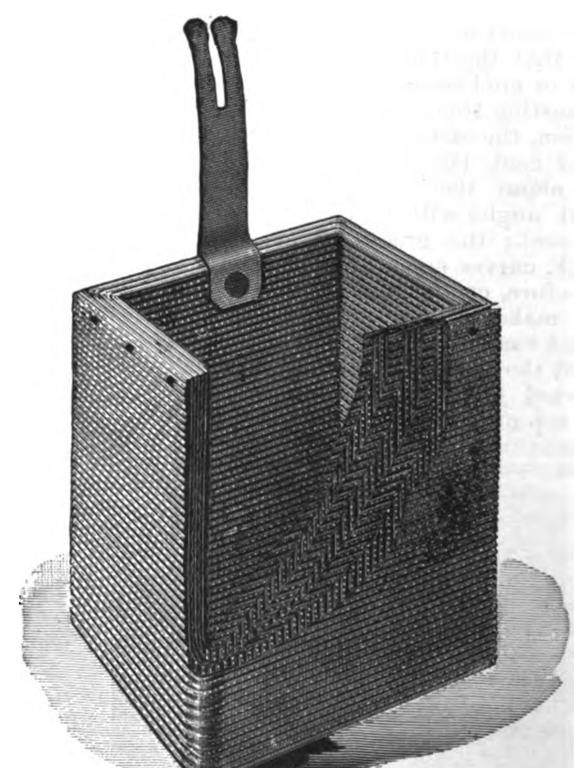


FIG. 4.

engine built by E. P. Hampson of this city, the latter belted to a 40 kilowatt Dallett generator wound for 550 volts and 70 amperes. As was mentioned above, the car runs into the barn at intervals that the batteries may be recharged, but it is intended soon to lay a cable to the depot end of the line and recharge while the car waits between trips, without loss of time.

The car has been running since the latter part of July

without a hitch of any sort, and has more than satisfied the expectations of the townspeople and even, in view of the condition of the road bed, the inventor himself. Another car will soon be added. Assisting Mr. Elieson, and superintending the construction and operation of the

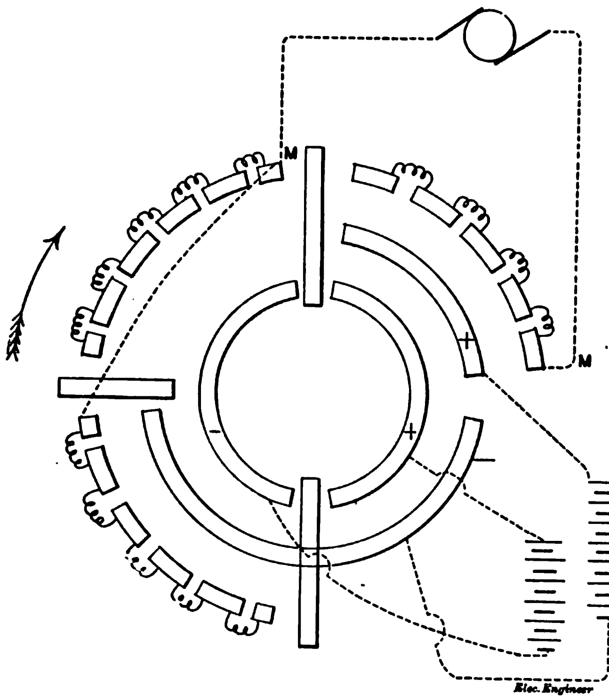


FIG. 5.

batteries, is Mr. E. J. Wade, an English electrician, long in charge of the large charging station for launches on the Thames, and hence peculiarly qualified for this class of work. Mr. Elieson hopes now that his little road is a complete success, to interest larger companies in his system and introduce it extensively in this country.

THE CORLEIS & RENISCH METHOD OF MANUFACTURING ARC LIGHT CARBONS.

IN the combustion of ordinary carbons, an annular layer of finely divided carbon particles is formed in proximity to the arc owing to a secondary combustion of the carbon. These particles are not useful in adding to the luminosity of the arc, but are dissipated or fall down and are wasted, in consequence whereof the carbons are reduced in cross-section and their life considerably shortened. To remedy this defect carbons have herotofore been impregnated or mixed with phosphate of lime, silicic acid, magnesia, borate and phosphate of magnesia, aluminum oxide, silicate of aluminum, oxide, boric acid, zinc chloride, copper nitrate, strontium nitrate, hydrate of potash, borax and sulphate of soda, phosphoric acid, and phosphate of ammonia or solutions of the same.

In order to prevent the secondary combustion and thus increase the intensity of the light and prolong the life of the carbons, Messrs. E. Corleis and H. Renisch of Essen, Germany, impregnate the carbons with substances such as tungstic acid or its salts which are not consumed at a white heat, but only in the luminous arc, so that the form assumed by the end of the upper carbon is more favorable for the emission of light.

From practical experiments made with impregnated carbons it has been determined that the life of carbons usually burning 18 hours, is increased to 21 hours—the limit being governed by the lower carbon, as the upper carbon remains in a condition to burn for about two hours longer. By increasing the diameter one millimeter a life of 23 hours was obtained, so that an increase of from 17 to 28 per cent. was obtainable.

The inventors have found that impregnation with a solution containing 25 per cent. of tungstate of sodium gives good results. Tungstate of potassium and tungstate of sodium are particularly adaptable to the purpose.

It is interesting to note that the firm of Fried. Krupp has purchased the patent on this method and will presumably make use of it.

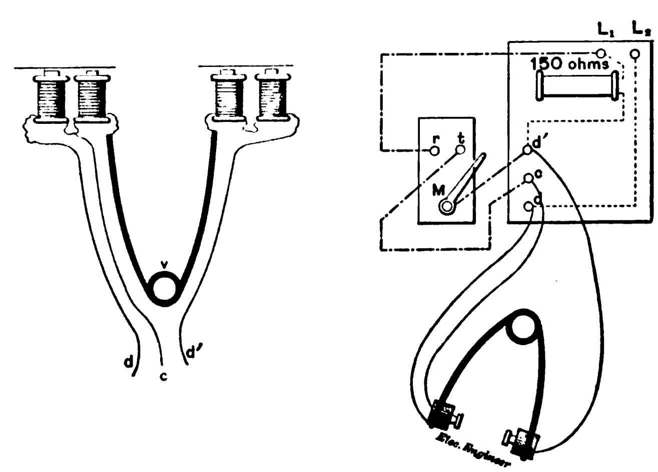
LONG DISTANCE TELEPHONY.

BY

J. Anizan

WHEN Alexander Graham Bell first brought out the telephone it was generally looked upon as a toy. Nevertheless when combined with the microphone it soon assumed vast importance The improvements which were made upon the original invention have been confined to the micro-telephone and to the telephone lines, principally to the latter. Thus induction has been prevented in neighboring wires by the metallic return, by the employment of anti-induction coils on telegraph wires, and by the helical arrangement of the telephone lines. Leaks to neighboring circuits so marked in damp weather have been prevented by connecting directly to the earth the telegraph insulator pins. The effects of capacity have been overcome by substituting for certain underground parts ærial conductors. Finally the resistance of the lines has been reduced by substituting copper for iron and steel.

As regards the microphone we find to-day two different systems, namely, those employing granulated carbon and those with carbon pencils. When first set up, the granulated carbon microphone gives excellent results which, however do not last long. Whatever the precaution taken, the carbon granules finally become packed under the influence of the vibrations and the microphone loses its original qualities. The carbon pencil microphones give less brilliant effects at the start, but their action remains constant practically for all time. It is this latter consideration which has given them the preference in Europe over the granulated carbon type.



FIGS. 1 AND 2.

As regards the telephone itself, it may be admitted that all systems in use at the present time, when properly constructed, are about equally effective, but I wish to point out here the functions and the influence on future work in this field, of the Mercadier bitelephone described in THE ELECTRICAL ENGINEER of July 12, 1893. It will be recalled that the bitelephone is arranged so as to remain attached to both ears automatically without inconvenience, leaving both hands free; while the right hand may be

occupied in writing, the left may be employed in operating a switch, the effects of which will be presently described.

To more fully understand what follows, it may be recalled that the bitelephone consists of two small telephones. Each of these little telephones comprises two bobbins of 75 ohms each. The total resistance of the bitelephones, therefore, is 300 ohms. The arrangement includes a flexible cord having three wires, shown diagrammatically in Fig. 1, the end wires *d d'* and the intermediate wire *c*. After what has been said the resistances will be as follows: By the circuit *d c*, 75 ohms; by circuit *c d'*, 225 ohms; by circuit *d d'*, 300 ohms. Fig. 2 represents diagrammatically a subscriber's station including an induction coil, the bitelephone and their connection with the small switch M, having two contacts, *r* and *t*. The switch is operated by the left hand while the right hand is occupied in writing.

Necessarily with two stations arranged in this manner, when one is transmitting the other receives, but it must not be forgotten that communication must be had under the same conditions as in ordinary communication, and that, in consequence, the person receiving must be able to interrupt at any time the person speaking at the other end. Two stations arranged for this purpose are shown in Fig.

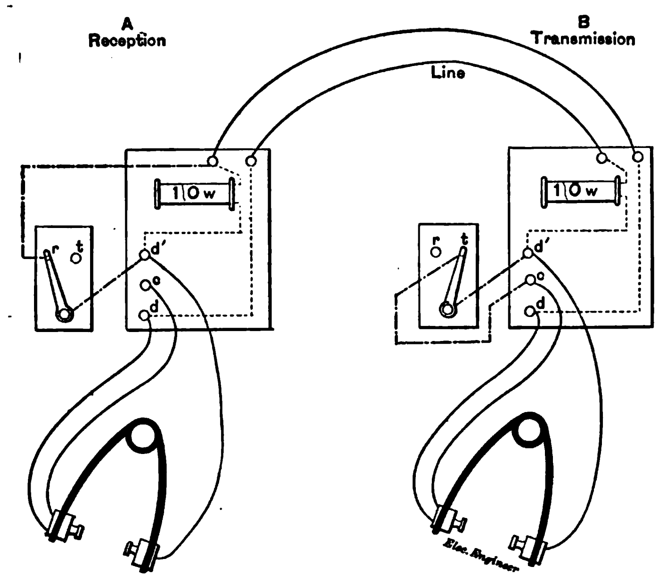


FIG. 3.

3 at A and B. At the station B, which transmits, the part *c d'* of the circuit is short circuited. There remains in circuit only the secondary of the induction coil, say, 150 ohms, and the part *c d* of the bitelephone, 75 ohms. Experience shows that even under these conditions the person transmitting can be interrupted from the other end of the line. It is true that the intensity is less than when all the bitelephone is in circuit and that the conditions are not best for receiving, but this very circumstance would notify the person transmitting that he was being interrupted. The latter would then stop and would throw the switch over to the receiving contact *r* in order to obtain the maximum intensity.

Fig. 3 shows clearly that at the station B the total resistance, which is 450 ohms, is reduced to 225 ohms. At the receiving end A the induction coil is short circuited by means of the switch and the resistance of the telephone is reduced from 450 to 300 ohms. Taking the entire circuit including both stations it will be seen that the total resistance is by this arrangement reduced from 900 to 525 ohms. When we consider that there is suppressed not only a resistance of 375 ohms but also the effects of the corresponding self-induction, the importance of the arrangement described will be understood. The resistance of both stations changes, of course, constantly, according to whether the stations are transmitting or receiving, respectively, but the total resistance remains the same.

In addition to the advantages described above this arrangement also presents another which is deserving of notice. When the microphone is arranged to transmit, the contacts must be made as sensitive as possible. One is limited in this direction, however, by the crackling sounds produced in the telephone of the person transmitting; but if, as in the station B, Fig. 3, only one part of the bitelephone is kept in circuit, the microphone may still be allowed to remain in its sensitive state, since the crackling sounds will not disturb the talker, while lending additional power to the microphone.

Long distance telephony is spreading rapidly, but more particularly in the United States. The arrangement described renders long distance communication practicable with copper wires, and with iron wires up to 250 miles, which without it would require copper wires. These results are of course only possible because the Mercadier bitelephone remains applied to the ears automatically leaving the hands free. The statements can be easily verified by actual test of a station arranged in this manner in the exhibit of the French Postal Telegraph administration in the Electricity Building at the World's Fair.

WASTED ENERGY: OR HOW NOT TO EARN DIVIDENDS.

BY C. A. S. H.

WHILE being shown over a large electrical factory not many miles from Boston, one is impressed with the amount of energy that is actually thrown away there. It seems surprising that an engineering company employed frequently to improve sources of energy for others do not examine their own factory.

In testing their large railway generators, large water rheostats which are troublesome and continually getting out of repair are used as a load, the energy being actually thrown away in decomposing water.

10 and 15 h. p. motors furnish power to lines of shafting in the different buildings, many of which are run continually from Monday morning to Saturday noon. The European engineers' custom of charging storage batteries with part of this wasted energy during the day to operate the motors required during the night might be considered to advantage.

The amount saved in the salaries of the night engineer, fireman, the wear and tear on the steam engines, the coal bill and care and repair of the rheostats would help compensate for the first cost and installation of the storage battery and undoubtedly exceed the running expenses.

It has been said by one of their engineers that they keep their steam engines working day and night so as to make as much use as possible of the money invested, while in fact they are really throwing away money in coal bills and salaries as they waste enough energy during the day to run them through the night. If they really wanted to operate their steam engine and burn coal through the night they might follow the plan of their New York brothers, in the city with the long name, and have one generator driven by the steam engine, furnish current to a similar machine which, run as a motor, would help drive the generator, the loss being taken up by the steam engine. In this way there is at least a saving of energy and no bother and repair of rheostats.

Ascertaining from the different foremen the output and average number of machines that are tested a week, and the length of time each is tested, it was found that there was actually thrown away in the form of heat and chemical decomposition, without considering machines of under 15 k. w. capacity, 8,299 k. w. hours, in the following proportion:

In 500 k. w. machines................	3,500 k. w. hours.
" 100 " "	2,400 " "
" 62 " "	1,488 " "
" R. R. motors...	911 " "

WORLD'S FAIR DEPARTMENT.

THE DESROZIERS CONTINUOUS CURRENT DYNAMO.

ONE of the most interesting exhibits in the French section in the Electricity Building is that of M. E. Desroziers, of Paris. The exhibit which is illustrated in the accompanying engraving, Fig. 1, is very well arranged and enables the visitor to obtain an exact idea of the apparatus under its different forms as well as of its numerous applications. From the numerous documents and photographs included in the exhibit we learn that the manufacture of the Desroziers dynamo goes back only a few years. The aggregate capacity of the machines in operation in 1891 did not exceed 12,000 h. p., whereas at the present time the capacity exceeds 20,000 h. p., and the installations in course of construction will increase this figure by more than half, before the end of the year. Among the principal applications of the Desroziers machine we may cite the lighting of large transatlantic steamers, warships, and torpedo boats of the French Navy; their employment as generators in the central electric light stations of Paris and a large number of private isolated plants. This would seem to indicate a large measure of success when we consider that the figures relate only to France and her colonies, where the activity in electrical work is not very great. It is interesting to note here also that the Brush Electrical Engineering Co., Limited, of London, have acquired the English patent of M. Desroziers. They have now adopted this type of machine for their continuous current dynamos in England and its colonies, with the exception of Canada.

This result is all the more remarkable in view of the fact that the construction of this type of dynamo, which in theory presents considerable advantages, had been tried by a number of other inventors, among them one no less illustrious than Lord Kelvin; but failure always resulted, owing to the practical difficulties which presented themselves. The first of these was the grave difficulty that these machines were not strong enough and could not stand prolonged service. Again the winding combinations, the arrangements of which vere practicable, did not admit of constructing the machines for various voltages, as would be required in regular every day shop construction. Finally the construction from a mechanical standpoint, was complicated and uncertain. All these difficulties were, however, removed by M. Desroziers. We will begin by giving a description of the most general type of the Desroziers machine, taking up later the theories involved which led the inventor to the adoption of this new type of dynamo.

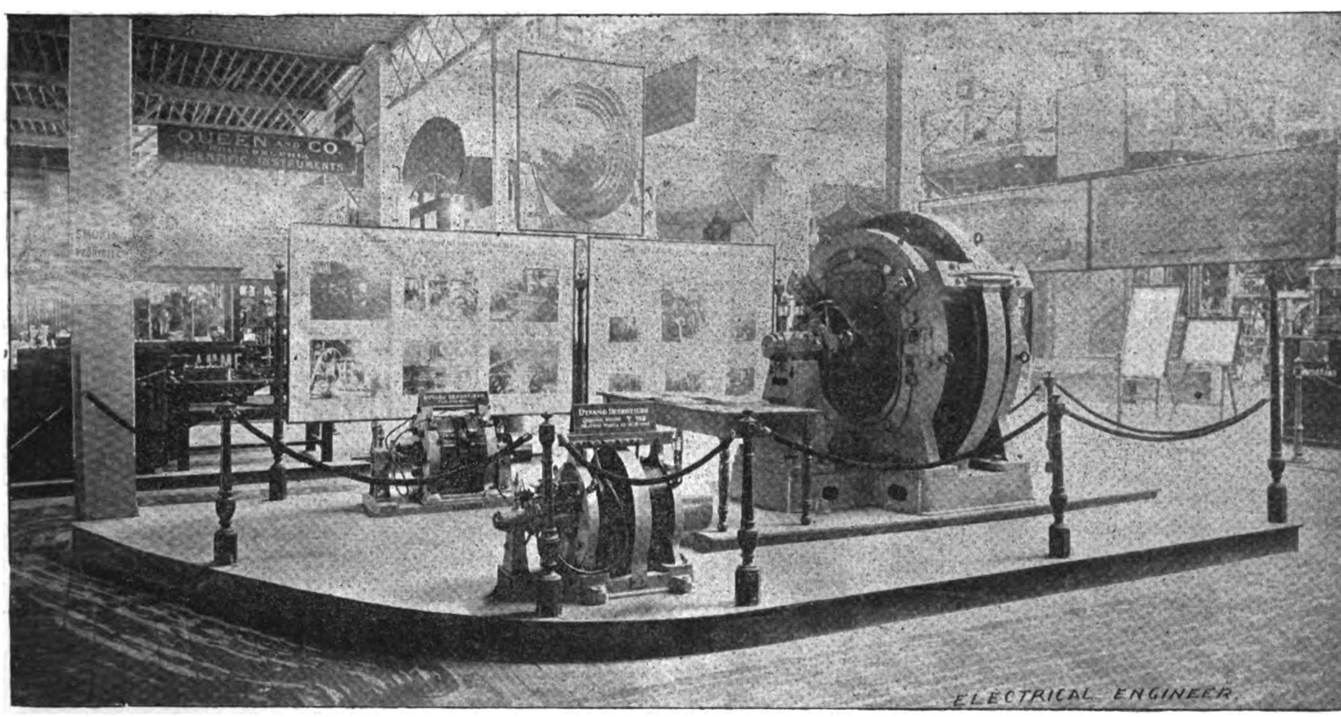


FIG. 1.—DESROZIERS EXHIBIT AT THE WORLD'S FAIR.

The Desroziers dynamo is a multipolar machine with a disc armature, or a circular flat and thin armature on which are placed the appropriate windings and which pass between the parallel and closely juxtaposed faces of the pole pieces. The principle of this machine, though well-known, is well worth recalling, however. Suppose, in Fig. 2, page 263, that two poles of the magnet N and S forming part of the magnetic circuit, face each other and are separated by a small air space. The lines of force going from one to the other will be nearly straight lines. If the wire, AB, for instance, turning about the axis XY passes between these two poles it will cut the lines of force at right angles and will be the seat of an E. M. F. Every other wire, such as BA', situated in an analogous position, will, likewise, be the seat of an E. M. F., the direction of which will depend on the direction of the movement with respect to the poles, and on the polarity of the latter. Each of the radial wires placed between AB and A' B will thus be the seat of an E. M. F.; the intensity and direction of which at each instant will

depend on their positions, respectively, with relation to the two magnetic fields. Evidently one may multiply the number of poles about the circumference of the circle which are passed over by the wires AB, and multiply the radial wires themselves to any extent. To collect the current thus produced, the different wires are connected together in such a manner as to obtain a continuous circuit in which the partial E. M. F.s add themselves to make up the required effect, and the armature sections are then properly joined to a commutator upon which the brushes rub.

The engraving Fig. 3 shows how these conditions are fulfilled in the Desroziers armature. The radial wires are arranged on an interior crown, on two sides of the armature, on hard paste-board which holds them in position. They are joined one to the other interiorly and exteriorly by means of curved wire connections, as shown in the engraving; we will show later on how these connections can be established in various ways. The different sections of the armature are joined to the segments of the commutator

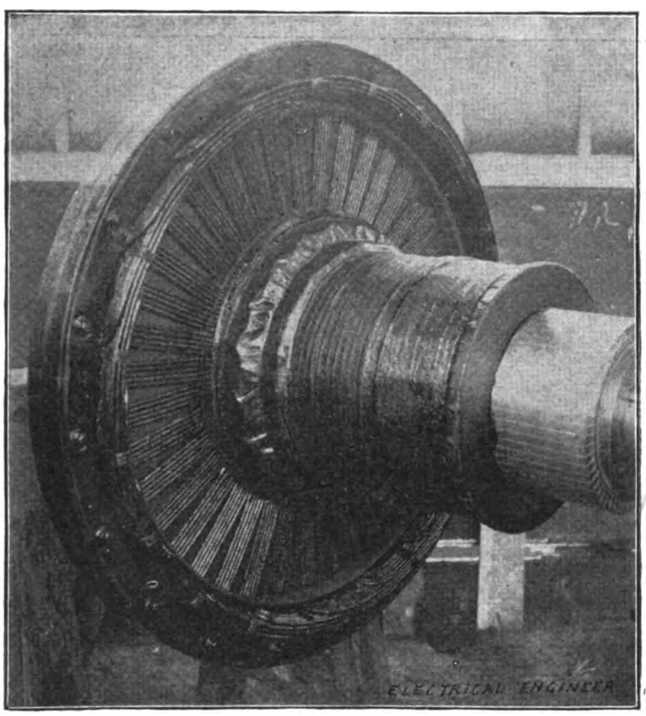


Fig. 3.—Desroziers Disc Armature.

where two brushes take off the current by means of a special connector. This device is rendered necessary by the multipolar arrangement of the machine and the series winding of the armature wires. It served to facilitate the interconnection of the sections which are symmetrically situated with respect to the poles, with the result that only two brushes are required. Fig. 4 shows the skeleton of the field magnets of a six-pole machine. The poles on the same side of the disc are of alternate polarity. Fig. 5 shows the machine assembled complete.

As we remarked above, the number of poles can be varied within the widest limits; thus in Fig. 1 there is exhibited at the left a small four pole machine, at the right a six pole machine giving 16,000 watts and in the background a large ten pole machine, of the following capacities:

At 150 revolutions per minute,	350 volts and	275 amperes.
" 215 " " "	500 "	" 320	"
" 300 " " "	730 "	" 350	"

This great flexibility of operation of the machine and the low speeds at which it revolves are some of its great advantages. These slow speeds admit of these machines being connected directly to the prime mover as is now being done more and more, not only in the special cases of ship lighting but in central station work also. In the case of direct connection, there is generally inserted between

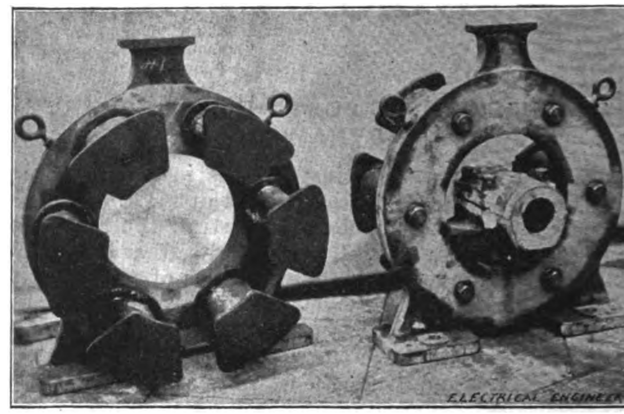


Fig. 4.—Field Magnet Skeleton of Desroziers Dynamo.

the shaft of the prime mover and the dynamo a Raffard elastic coupling. We show in Figs. 6, 7 and 8 three types of the direct coupled arrangement. The first represents a steam dynamo, adopted in the French Navy, and which can be seen in the exhibit of the firm of Breguet, of Paris, in the Electricity Building. These steam dynamos have three uprights for the bearings. A combination of this type is able to furnish 4,200 watts at 500 revolutions; it weighs only 1,320 pounds and has a total height of about three feet. Fig. 7 represents the central station of the Popp Co., in the Boulevard Richard Lenoir in Paris. In this station four Weyner-Richmond engines running at 145 revolutions drive eight dynamos, of 100,000 watts each. Notwithstanding their large output, these dynamos operate at a potential difference of 2,400 volts and often at 3,200 volts and over. This plant is considered a model one owing to its elegance and the small space occupied by the generator. More recently, by the aid of the Raffard elastic coupling it has become possible to drive directly with a Crossley two revolution gas engine, at 250 revolutions a minute. The engraving, Fig. 8, shows an installation of this kind with a capacity of 4,200 watts.

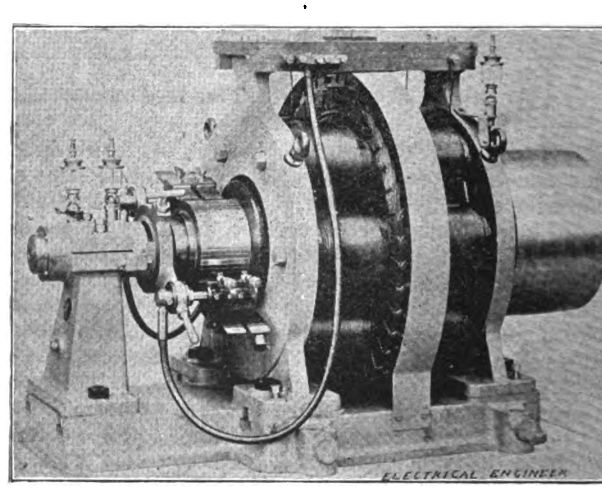


Fig. 5.—Desroziers Multiple Disc Dynamo.

These "gas-dynamos" have been very successful in small private plants and also in central stations. The light is absolutely constant and, what will appear more extraordinary, the regulation is obtained automatically and instantaneously at the dynamo and at the engine.

We have described above the principle of the disc ma-

chine and pointed out the difficulty which had stood in the way of its practical construction. We shall now see, however, the principle of construction adopted by M. Desroziers in his machine, and for simplicity, we shall assume the case of the disc. In order to collect a continuous current

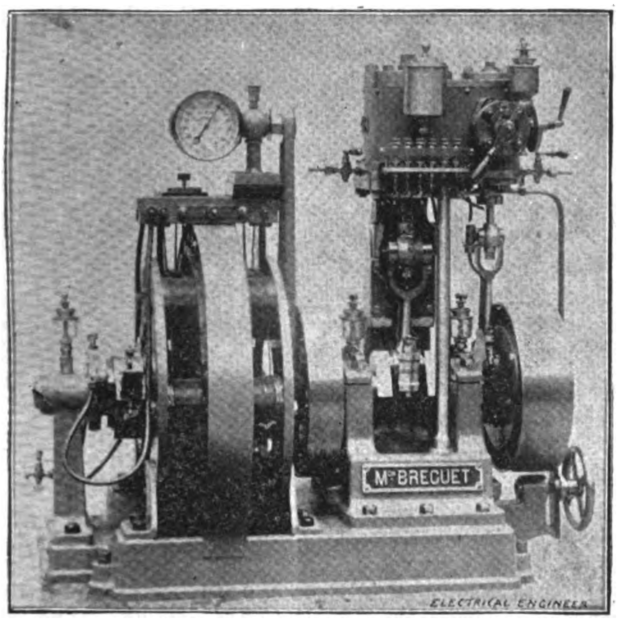


FIG. 6.—DESROZIERS MACHINE DIRECTLY CONNECTED TO BREGUET STEAM ENGINE.

with a series winding and only two brushes, it is necessary to have a winding which satisfies the same conditions that exist in the Gramme ring; that is the say, there must be arranged two series starting from the same wire for which the E. M. F. developed is zero, and each formed of wires in which the E. M. F. developed goes on increasing without interruption up to a maximum from which point it decreases again to zero at the second junction wire of the two series.

All the regularly closed circuit windings can evidently be reduced to two types : (1) The regular polygon wind-

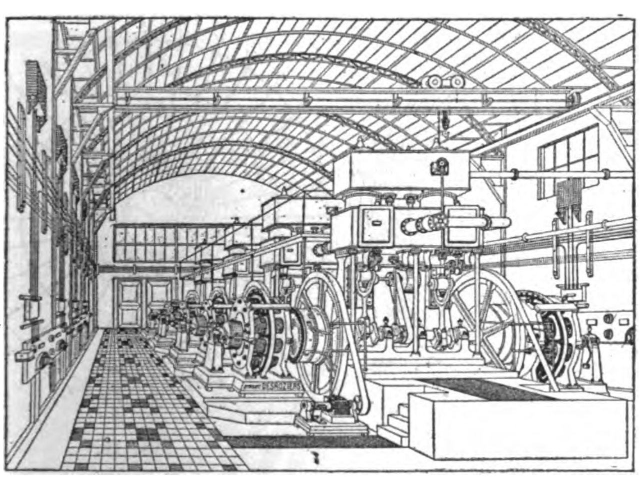


FIG. 7.—POPP STATION, PARIS.

ing, Fig. 9, and (2) the star polygon winding, Fig. 10, in which the sides of the polygon, Fig. 9 are replaced by wires of any form ending at the same terminal point. But if we try to connect the different wires among themselves, in order to satisfy the electrical conditions set down above, we run against considerable practical difficulties which result, for the most part, in the connecting wires cutting at each instant the radial conductors, and these different conductors are superposed. After a thorough analysis M. Desroziers discerned that they could be separated into successive alternate identical parts. By numbering these elements according to the natural sequence of the numbers, all the even elements, that is to say, beginning from an even top, Figs. 9 and 10, are identical, and likewise the odd elements. It is, therefore, only necessary to separate the elements in two groups and to place the odd elements on one surface, and the even elements on a neighboring parallel surface, but preserving for each its relative position. Thus the corresponding terminals of these elements touch each other, and it suffices to solder them in order to complete the original closed circuit winding. Under these

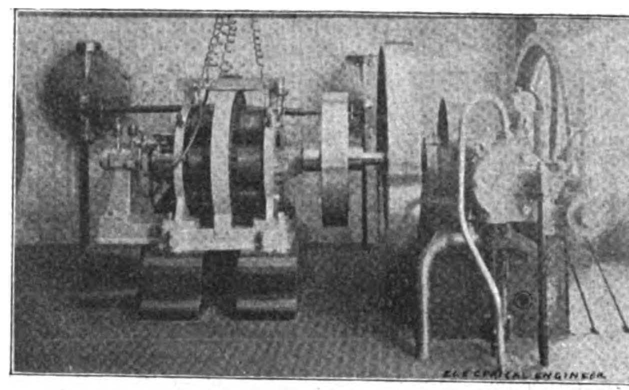
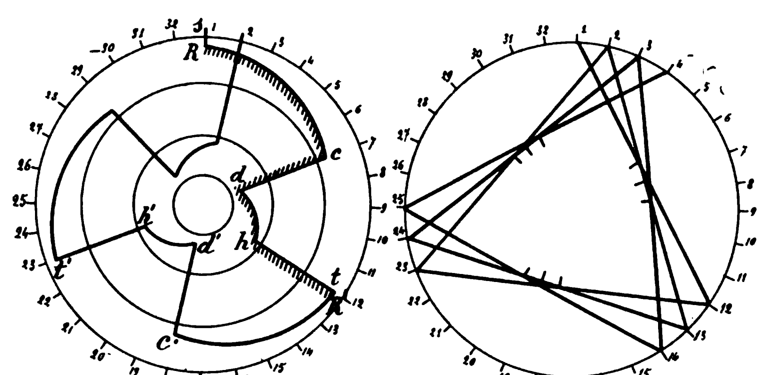


FIG. 8.—DESROZIERS DYNAMO DIRECTLY DRIVEN BY CROSSLEY GAS ENGINE.

conditions, the successive, separated like elements can be formed of convenient parts and simply placed opposite or side by side without cutting one another, as, for example, by radial parts, or those in the form of a cycloid or parts parallel to each other. The placing of the like elements can be done separately under practical conditions on two plane parallel surfaces. These two surfaces are then placed one against the other so that the wires of the two planes are so situated that the closed circuit winding can be reestablished by simply joining the ends of the corresponding elements which then adjoin one another.

In practice, these plane surfaces are rings or crowns of compressed insulating material which are fixed on a thin



FIGS. 9 AND 10.

metallic disc in the shape of a star inserted between the crowns before the ends of the corresponding wires are soldered. There is thus formed a symmetrical whole, strong in construction, forming an armature in excellent condition to resist all disturbing influences.

A number of examples will suffice to understand the method of classifying the elements. The classification can

be made in two principal ways: (1) By numbering the successive lines which replace the sides of the polygon; in this case the odd lines can be identical as well as the even ones, as shown in Figs. 9, 10, 11 and 12 which represents the case of a star polygon of 52 sides, corresponding to a six pole dynamo. The line R *c d h t*, Fig. 9 represents the type of the odd lines, and the line R' *c' d' h' t'* represents the even line. In these figures the different parts are composed simply of radical parts and other parts consisting of cycloids. Figs. 13, 14 and 15 show this arrangement in the case of a regular polygon of 24 sides, corresponding to a dynamo with six poles; *s g h t* (Fig. 20), shows the type with the odd line and *s' g' h' t'* with the even line. The even and odd parts are each grouped on a side and the diagrams show their juxtaposition.

(2) Let us divide on the contrary each line which replaces a side of the polygon, into two parts and number the parts successively. All the first parts which are even are identical among themselves, and the same is the case with the second parts which are odd. In Figs. 16, 17, 18 and 19, which relate to a case of a star polygon of 32 sides, the part *s c d* is the odd part and *g h t* the even part. Both parts are represented as grouped together. Other methods of classification can be adopted, the details of which, however, would carry us too far. We will, therefore, now take up the method of fixing these various elements on parallel surfaces in the shape of a disc.

In the case of conductors in the form of wire, M. Desroziers employs two thin crowns of compressed card board to hold the odd and even wires. The crowns are divided into a certain number of appropriate sectors and in three concentric crowns. They are perforated in regular order on their outer and inner circumference. In passing the wires through the holes, which constitutes a system of stitching, the radial parts are placed on one side of the disc and the curved or cycloid part on the other side; thus, in the case illustrated in Figs. 8, 9, 10 and 11 the wires are placed as shown in Figs. 20, 21 and 22. The short lengths RR_1, cc_1, dd_1, hh_1 which pass through the cardboard connect the curved parts to the radial parts, the final form of the element being shown in Fig. 22.

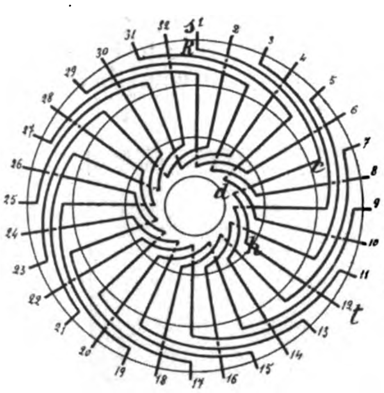


Fig. 11.

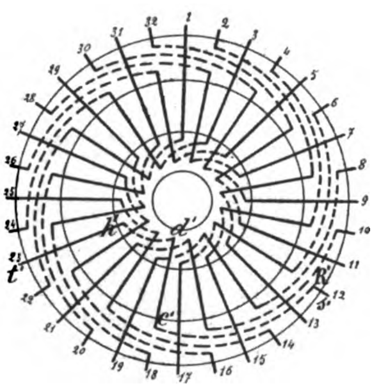


Fig. 12.

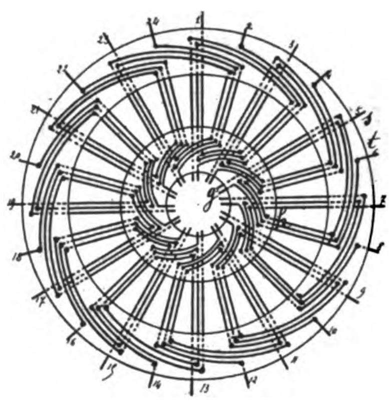


Fig. 13.

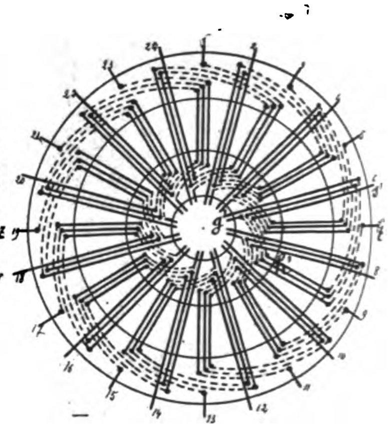
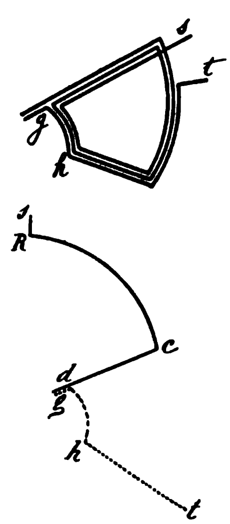


Fig. 14.

Fig. 23 represents in section the two discs thus wound and joined by the insertion of an intermediate star fixed to the shaft. The crowns of card board are fastened on the star; the cardboard where it projects above the circumferential cycloids and below the central ones, is cut away. In the other cases of winding, the same method of mounting is employed. The method of winding admits of making a number of hanks. Fig. 24 shows the method of cutting in that case. The like parts, instead of having the form Fig. 25, have the form shown in Fig. 26, which shows a case of right-hand winding. In that case the winding, seen from the side of the radial parts, after the cutting away of the crown, has the aspect shown in Fig. 27. In the case of the regular polygon, Figs. 13, 14 and 15 represent the windings of the even and odd



Figs. 15 and 17.

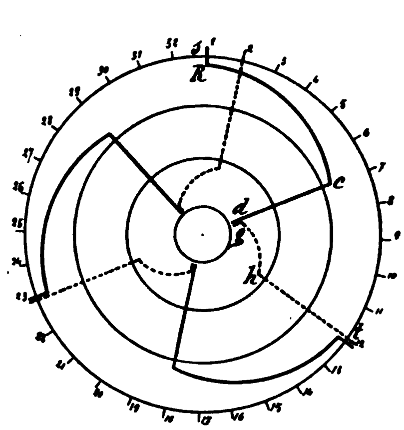


Fig. 16.

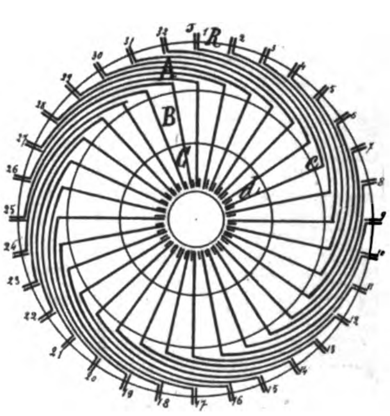


Fig. 18.

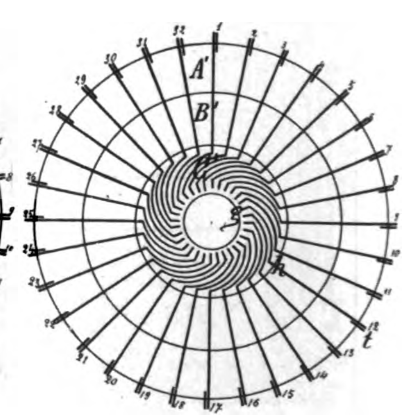


Fig. 19.

parts as seen, the one from the side of the radial parts of the elements, and the other from the side of the curved parts. It is this system of multiple winding which admits

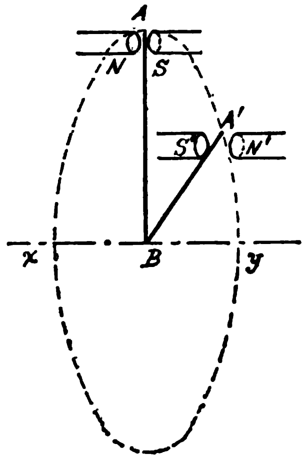


Fig. 2.

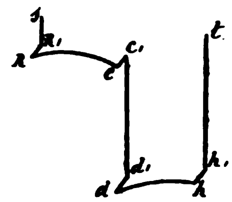


Fig. 22.

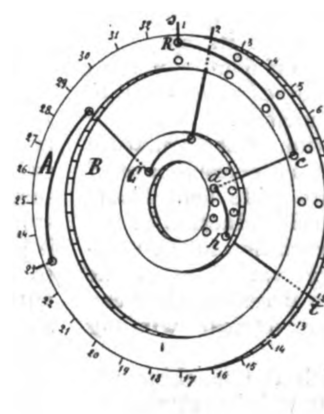


Fig. 20.

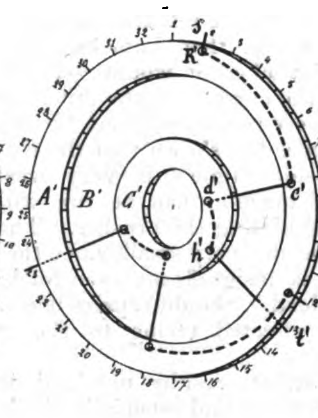


Fig. 21.

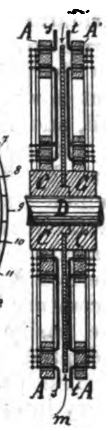


Fig. 23.

of the obtaining of the desired voltage, however high it may be, because it can be done methodically in several layers.

The above explanations relate to the case of wire con-

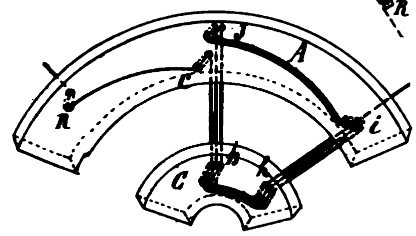


Fig. 24.

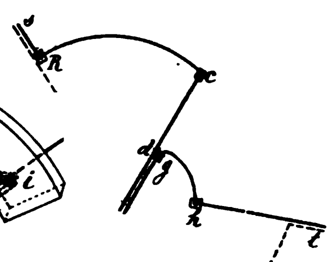


Fig. 25.

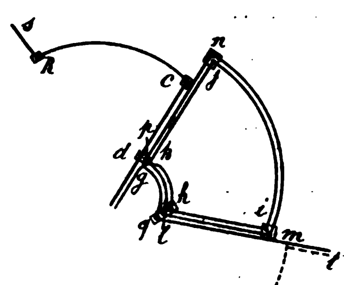


Fig. 26.

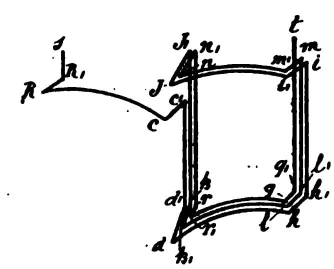


Fig. 27.

ductors; when sheets are employed the cardboard crowns can be dispensed with, more especially in certain cases where the radial and curved parts can remain in the same plane, as then they do not intersect each other.

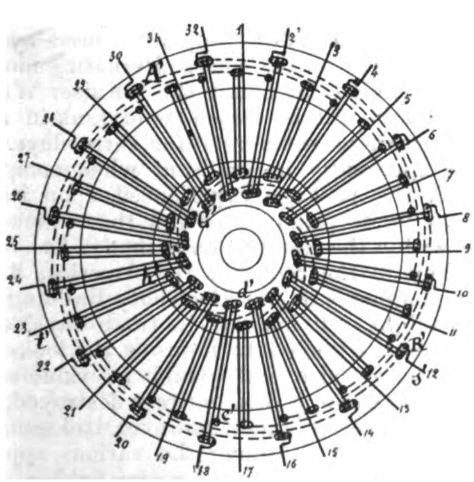


Fig. 28.

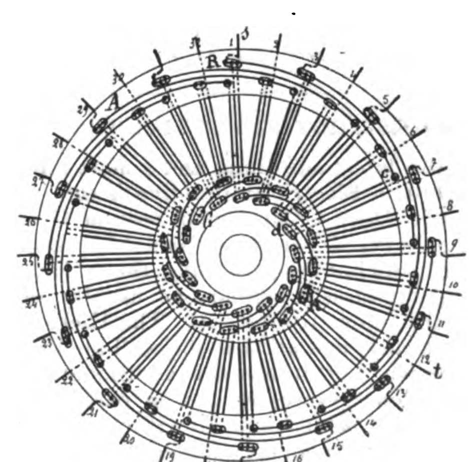


Fig. 29.

To recapitulate, with this method of construction there is obtained a winding, methodically classed and joined, thoroughly well insulated and ventilated, besides fixed by small groups passing in the same hole on an excellent insulator, compressed cardboard. As to the strength of the armature, experience has fully demonstrated that it is able to withstand successfully the most prolonged, heavy strains. From the physical standpoint, also the Desroziers machine possesses advantages; thus the absence of iron makes the generation of Foucault currents impossible, and hence the heat usually generated from that cause is absent. The ventilation is such, that the machine can be heavily overloaded, without causing destruction of the armature wires, while its stiffness enables it to withstand all lateral disturbing influences.

The extreme lightness of the armature also presents an important advantage. Thus let us suppose a case of a number of dynamos coupled directly to their engines by the Raffard coupling with rubber rings, the machines

being joined in parallel. Any accident to, or slowing up of, the engine would cause an inverse current from the other dynamos to flow into the affected machine; the latter would slow up still more, the inverse current would increase enormously, the rubber rings would break, the armature would be set free as well as the engine. The armature would then immediately increase its speed up to the point where it would generate sufficient E. M. F. to cut down the current of the other machines practically to nil, and there remain without further mishap.

Experience has shown that the reaction of the armature on the field magnets is very weak, in consequence of which the machine can be run within wide load limits without regulating the brushes. The self-induction of the armature is also very small, since the variation in the magnetic flux is insignificant even for large variations of the armature load. Should repairs become necessary they can be easily effected owing to the symmetrical winding adopted.

The practical results obtained with the machine are very interesting, and especially the low weights attainable with this form of construction. Thus at normal speeds these machines weigh only from 55 to 65 pounds per horse power. The efficiency is also high, as indicated by the figures which we give below, relating to a machine of 100,000 watts capacity when running at 160 revolutions per minute, that is, at low speed.

		or
Current in amperes	800	180
Volts	130	650
Revolutions per minute	160	
Total weight of machine	20,460 lbs,	

Armature.

Mean diam	55.5 inches	
Diam. of wire... 5 wires of 5.7 mm. each joined in parallel.		1 wire of 5.7 mm.
Number of twists in series	112	
" " collector segments	140	
Resistance between brushes	0.0065 ohm.	
Weight of wire on armature	563 lbs.	
" " of connectors	132 "	

Field Magnets.

Weight of wire	968 lbs.
Resistance, warm	5.2 ohms.
Number of poles	10
Electrical efficiency	93.1 per cent.
Commercial efficiency	91.0 " "

At its normal speed of 300 revolutions per minute this machine produces 210,000 watts and at an efficiency close on to 93.5 per cent. On the machines at the Boulogne-sur-Mer central station, running at 350 revolutions, an efficiency of 93.5 per cent. has been obtained.

THE HICKS-TROY ELECTRIC DOOR OPENER.

ONE of the latest additions, and a most interesting one, to the exhibits in Electricity Building is that of the Hicks-Troy Electric Door Company in Section U, space 15, of the South gallery. There have been door-checks designed by the score which, though having the advantage of closing the door noiselessly behind one, usually required more than ordinary effort to open it. The Hicks-Troy device, however, not only does all that the well-known door checks now accomplish, but it has the additional advantage of opening the door before the person passing through and closing it silently behind him, all without requiring a touch of the finger. The medium adopted to accomplish this is, of course, electricity, and the inventors, Messrs. O. H. Hicks and R. F. Troy, have worked out the arrangement in an exceedingly ingenious way.

To begin with, we may state that the door in one of the arrangements is hung on spring hinges, and the tendency of the springs is always to swing the door open. To the top of the door is attached a cord which runs over a set of pulleys to a little electric motor the function of which is to wind up the cord and to pull the door shut and keep it shut, at the same time winding up the spring which opens the door.

This, in general terms, is the whole mechanism, but a few details are necessary to understand its working. The person approaching the door steps on an electric mat which closes a circuit, setting free the cord connected with the motor and allowing the door to be swung open by the springs. We will now pass to the motor and see what takes place there. In the pulley box over the door are two switches. A pin on the door arm cuts out the motor by snapping the switch in the housing over the door, thus stopping the motor when the door strikes shut. The motor is placed within an iron box in any convenient place and to its armature shaft there is attached a worm-gearing with a worm-wheel carrying a set of magnets that attract an iron plate. This plate also carries a grooved cam around which the cord that closes the door is wound. This cam movement pulls upon the cord with a leverage which is weak at the beginning and grows stronger, being at its maximum when the door is closed, that is, when the spring which tends to open it is also at its maximum tension. As soon as a person steps on the mat the circuit of the motor is opened at a switch in the motor box. This releases the iron cam plate from the influence of the magnets above referred to, frees the cord, and allows the springs to open the door. As the person steps off the mat the switch at the motor closes the motor circuit, the armature revolves, the iron brake disc is attracted by the magnets and the door is wound shut. As soon as it strikes the pin at the top of the door, however, it breaks the motor circuit, but leaves the current still on the magnets which attract the iron cam plate and it thus keeps the cord under tension and holds the door closed. This iron disc acts as a brake shoe, as it were, and forms a flexible coupling between the motor and the cord. The action of the person stepping on the mat will now be understood to release this brake shoe, freeing the cord and allowing the springs to open the door.

The exhibit includes a number of doors fitted with the door-opening and closing device and attracts a great deal of attention. The current required for operation does not exceed ½ ampere at 110 volts.

THE FERRARIS ROTARY FIELD MOTOR—HISTORICAL EXHIBIT.

AMONG those who were asked to contribute to the historical collection in the Electricity Building was Prof. G. Ferraris, of Turin, Italy, and in May of this year he shipped to this country the apparatus used by him in his early experiments on two-phase alternating motors. The package was placed on board the "Kaiser Wilhelm" at Genoa, which, it will be remembered, sank in the harbor of Genoa, remaining submerged for three days. But this delay was apparently insignificant when compared with that which the package experienced upon its arrival in this country in its passage through the custom house, for it is only within the last few days that it has been set up for exhibition in the rooms of the American Institute of Electrical Engineers in the Electricity Building.

As one might well imagine, its three days' submersion has by no means tended to improve the looks of the apparatus but as an historical exhibit its value would have been much decreased, if not entirely destroyed, by undertaking repairs. As it stands, however, it does not seem to have suffered much. Among the various apparatus exhibited is shown a model of a rotary field motor with a vertical copper cylinder rotating in the field produced by means of two coils crossed at right angles. Each coil has its own pair of binding posts. The outer coil 6 inches high is wound in a frame having a groove 1¼ inch in width filled with No. 12 silk insulated wire. The other coil is wound double with two wires of about No. 18 gauge; the

two wires being joined in parallel with their ends connected. The copper cylinder is 3½ inches in diameter.

The apparatus labeled No. 2 is Prof. Ferraris' first rotary field motor with horizontal axis and copper armature. The two currents with different phases were obtained either by means of a Gaulard and Gibbs transformer or by means of two parallel circuits with different inductances and resistances. Thus we find in the apparatus one of the coils composed of two No. 14 wires wound parallel and the other coil also consisting of two parts and joined in parallel, of No. 18 wire. The cylinder of this model is 7 inches long and 3½ inches in diameter. Another type of motor with rotary field is a little multipolar machine with iron magnetic circuit, and having an iron armature. The four field cores of this machine are of wrought iron arranged as usual, radially around the axis of the armature. To complete the magnetic circuit the outer ends of the magnet cores are joined by having a layer of No. 20 iron wires wound about them to a thickness of ¼ of an inch. The iron cylinder in this machine is three inches long and 1½ inches in diameter, the model itself standing about 8½ inches high. Besides these models there are also shown a number of solid and laminated iron cylinders used by Prof. Ferraris.

THE "MOMENT OF REVERSAL." IN QUADS.

BY

Stephen D. Field

THE article of Mr. Wm. Maver, Aug. 16th last and that of Mr. Grandy on Sept. 13th, tempts me to add a word to the discussion and to suggest that the true way to improve the quadruplex should be by simplifying the organization rather than by adding more apparatus to it.

The so-called "bug" in the quadruplex is caused by that portion of the line current which finds its way into the condenser of the equating circuit through both coils of the relays, being directed in its passage to earth by the resistance usually found in the battery circuit.

This battery resistance immensely increases the self-inductive capacity of the relays by causing more or less of arriving current to traverse all of the coils in series instead of passing direct to earth as would be the case were it not present.

When the battery resistance is eliminated not only is the coil resistance of the currents to earth materially diminished, but the inductive currents set up in the equating circuit during their passage are mutually reactive on the line currents, with the effect that the line is more speedily closed and the no current period on any practical circuit becomes of so short duration as to be wholly negligible.

With the battery resistance eliminated, the neutral relay no longer falls off during reversal and the so-called "bug" drops out of sight. I have worked a quadruplex with the above results where I had but 75 ohms battery resistance as an accompaniment of a potential of 300 volts. The signals were perfect and no bug trap was employed.

It is also perfectly feasible to obtain all four transmissions with but 25 ohms coil resistance at either station, but as Kipling says: "That is another story."

TRANSFORMER PATENT LITIGATION IN FRANCE.

THE Orleans Court of Appeal has sustained the Zipernowsky-Déri patent, dated March 20, 1885, which claims the parallel arrangement of transformers and also the Zipernowsky-Déri-Blathy patent, dated April 21, 1885, covering the use of closed magnetic circuit non-polar transformers. The judgment of the Court of Appeal reverses that previously given by the Tribunal Civil de Tours, and is based entirely on the report made by three experts, MM. Fribourg, Jousselin, and de Parville.

A FENCE TELEPHONE.

AN innovation in telephonic communication has been adopted in Victoria, says the London *Electrician*. The idea consists in adapting the fencing wire running along the boundary as a means of transmitting sound. At the straining posts connections have been made, and at each gate or road a short overhead line has been erected clear of all traffic. At either end a small electric battery and transmitter is placed, thus bringing the stations, which are seven miles apart, within easy and convenient speaking distance. The cost of transforming the fence into a telephone line has been exceedingly small, and with the small annual cost of chemicals for the batteries, a complete, cheap, and serviceable connection is secured. The same idea, it may be stated, has been tried in America.

PENNOCK—HERE HE IS AGAIN.

WALL STREET authorities like the *Journal of Finance* would do well to put themselves upon inquiry before printing items like the following from a recent issue of that paper.

Electric.

George B. Pennock, of Riverton, N. J., advises investment in the stock of his company now selling at $25. He predicts that it will sell at $100 within one year The Pennock battery, he says, can produce 1,000 electric lights 900 per cent. cheaper than the dynamo. A plant is being erected at Boston and an exhibition plant is running at Bridgeport, Conn.

Every one possessing either technical or business knowledge of electricity has for a long time been either indignant at or amused by the persistency of Pennock's pretensions and by his success in getting himself and his humbug noticed by respectable papers. Amusement is tempered, however, by the reflection that there may be ignorant investors enough to supply Pennock with money to live on.

A leading electrical engineer writes us:

"I was in Bridgeport yesterday and ran across Pennock again, the primary battery impostor, whom you probably know the career of in fleecing the general public in Chicago and Chattanooga. I think that he ought to be exposed thoroughly by those interested in the electrical profession. I enclose you herewith one of his circulars. By means of 1 h. p., he tells me, he will, by means of his multiplier, secure an absolutely unlimited amount of power, and he proposes to run the ocean steamships with 1 h. p. through his method.

"I saw his exhibit and had a long talk with him. He has a revolving commutator, which he says throws the current from one lamp to another, so that the current is on each lamp but a short space of time, and by an optical illusion, as he states, the number of lights which can be operated is unlimited from any particular amount of power.

"While I was there, there were half a dozen parties in the room, to whom he was explaining the beauties of his system, and he was offering stock in the local State Co. at 25 cents a share, and in the parent company at $25; the par value of the parent company is $1 per share, but has already reached a value on the market of $25. I thought that a couple of the persons were 'cappers' for his scheme; they appeared to be ignorant farmers, but their questions were a little too leading and made me suspicious. Perhaps it might be worth your while to send some one up to Bridgeport to expose this fraud."

"GUESS WORK" WIRING.

THE following suggestive item is from the Kansas City *Architect*, which has an excellent electrical department: "At one time we referred to some lead fuse wires about a half inch broad and a thirty-second thick, which were taken from a hotel then but recently built. Our city inspector had them. Too large fuses are easy to find where men wire by "guess work." Within a few days, two pieces of Number 16 copper office wire were taken from a fuse block. The "plugs" had blown so often that the "electrician" (?) in charge, instead of searching for a ground in his wiring, had constantly put in heavier fuse wire. The timely discovery of this trick saved a large fire. The wire in an electrolier had actually fused to the metal of the electrolier. In order to save the cost of inspection and a remedy for this "ground," he had undertaken to force the current over the obstruction with the above result. These private plants should be inspected at least every six months."

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A NOVELTY IN ELECTRIC RAILWAY FRANCHISES.

THE City of New Orleans has just sold for $700,000 cash down, to the New Orleans City & Lake Railroad Company a renewal from 1906 until 1956 of that company's extensive street railway franchises. This is certainly a novelty in the granting of franchises, so long before they begin, but the company wanted to be sure of its protection before making a proposed heavy investment in electric traction, and apparently did not consider $700,000 too much. The company has thus given itself a lease not short of 63 years from the present time, and can go ahead with its electrical work, in the consciousness that it is safe from interruption or competition during all that period. The public and the local papers seem well pleased with the bargain driven, and speaking in the interests of electric traction we see nothing to find fault with. The sum really amounts to $1,246,000, with interest counted in, and that is a pretty handsome figure for the franchise even in such a city as New Orleans. The electrical system will be installed forthwith, and the mule will disappear from the City Railroad lines as he has already from the Carrollton, as described not long ago in our columns so graphically by Mr. A. Langstaff Johnston. Uncertainty of franchise tenure must always militate against extensions and improvements, and the practice adopted in New Orleans has much to recommend it on public grounds.

MULTIPHASE MOTORS.

WE have already referred to the predominance of the papers involving alternating current work at the Electrical Congress and the strong indications which that fact gave as to the drift of modern work and thought in electricity. The discussion which took place on multiphase motors and transmission of power was, taken all in all, perhaps the most interesting and valuable which has thus far been recorded. Among those who participated in it were a number of men who had made a study of the subject from the theoretical and others from the practical and experimental standpoint. The discussion, if it demonstrated anything, showed that we are in a period of transition and that finality may not be reached for some time to come. An analysis of the opinions would seem to show that those who have limited themselves more particularly to the theoretical side of the question inclined more to the belief that the single-phase alternating motor will supersede all others, while those who have had more experimental and practical experience inclined to the multiphase and more particularly to the two-phase system. Considering the present state of the art, the system recommended for adoption to the Cataract Construction Co., by Prof. Geo. Forbes must be conceded to be perhaps the best which could be installed. The arguments which he brings forward in support of the recommendations made by him must carry conviction, for, as he points out, the system can be employed immediately in two-phase work, while nothing stands in the way of its utilization for single-phase work should motors or apparatus of that type reach a practical stage in the future. The diversity of opinion as to the practicability on an extended scale of the three-phase system employing three wires will, it appears to us, tend to divert attention from that system, at one time lauded to the skies, and serve to concentrate work on the two-phase and single-phase. From the hints which were thrown out during the discussion, one might well be led to believe that recent, as yet unpublished, work had brought us nearer the practical solution of this method than anything thus far advanced; and with such able experimenters as Mr. Steinmetz and others at work on the problem, interesting results may be looked for. We must, however, confess surprise and doubt as to the statements made during the discussion by Mr. H. C. W. Hasson, who considered that electrical power transmission as practiced thus far in California is a failure. If such be the fact—which we take leave to question—then we are sure a remedy can and will be supplied.

RETURNING PROSPERITY.

ON all sides it is apparent that electrical industry and trade are feeling the revival of business confidence and credit that set in soon after the vote of the House of Representatives to repeal the Silver-Purchase Act. Electrical manufacturers and dealers have borne their share of the general misfortune of the summer remarkably well and are among the first to participate in the advantages of the improved financial situation. The columns of THE ELECTRICAL ENGINEER bear witness to the initiation of large numbers of new lighting and power enterprises, while manufacturers and supply houses report inquiries and orders increasing largely over those of July and August. It would be irrational to expect an immediate arrival of flush times; the accession of new business and the revival of old must necessarily be gradual; but the tide has distinctly turned, and, in a business founded upon useful arts so rapidly expanding in number and scope as those of applied electricity, the gain in volume may be expected to be at an accelerating rate beyond that of most trades.

In one important circumstance the electrical situation has undergone a marked change in a year. Last autumn the General Electric Company, with its Edison patent, its huge agglomeration of manufacturing plant and its widespread selling organization, was regarded as a portent of disaster, or perhaps of ruin, by the many smaller and independent establishments. Its position and the condition of its business now constitute a much less formidable menace to its competitors. Everyone sees that it cannot achieve a monopoly of electric light and power.

ELECTRIC RAILWAY DEPARTMENT.

THE BERLIN ELECTRIC RAILROAD.

THE project of Siemens & Halske for an electric viaduct railroad designed to complete the Metropolitan system of Berlin has been approved by the Imperial Government, says the *Railroad Gazette*, and is about to be put in process of execution. The existing Metropolitan road in 1882 carried 9.3 million passengers and has now reached an annual traffic of 33 millions, including the belt road. This service crowds the system so much that the headway of trains has been reduced to what is considered a minimum and the tracks destined originally for through traffic only are used for local traffic as well. The Siemens & Halske project is designed to furnish supplementary transverse lines north and south and east and west.

Although this is called a viaduct line, portions of it will be in tunnel where the conditions lend themselves to shallow tunnels, and other portions will be on the street level. The portion in tunnel will amount to about 7 or 8 per cent. of the whole. The present construction will be: (1.) An east and west line from the Metropolitan station, just west of the Spree, to Charlottenburg, which will be entirely on viaduct; (2.) A line from the Friedrichstrasse station, in the heart of the city, southerly and then westerly to the Grünwald suburb. Of this, a short portion in the heart of the city from the Friedrichstrasse station to the Pottsdam station will be in tunnel. The portion from the Pottsdam station to the east and west line previously mentioned will be on viaduct; and the strictly suburban portion will be at the street level, but so designed as to be transformed into a viaduct line eventually; (3.) A viaduct line from the Friedrichstrasse station northerly to Pankow, viaduct and surface.

The gauge will be the German standard, 4 feet 8½ inch., but the height of the cars has been reduced so that the normal clear height will be 3.15 meters, permitting the minimum depth for the tunnel and facilitating the passage from tunnel to viaduct. The cars will be mounted on two trucks, each of which will have an electric motor; they will be 2.25 meters wide and the standard clearance of tunnels and structures will be 3 meters wide. It is estimated that the weight per wheel will be from 1.3 to 1.5 tons.

Stations will be reduced to the most simple possible form, having no waiting-rooms, but mere sheltered platforms three cars in length. At one end of the platform will be an entrance stairway where tickets will be sold, and at the other an exit stairway where the tickets will be taken up. The design for the viaduct will be very simple and economical; the clear headway at the street crossings will be 4.4 meters, the depth of the roadbed from the top of the rail to the overhead clearance being 0.55 meter. It is proposed, however, to decorate the viaduct in accordance with the artistic demands of the capital. In the tunnel part, the clear width of which is 6.75 meters, the construction will be retaining walls with an inverted arch beneath and transverse beams above to carry the street pavement. The width required for the walls and clear spaces will be 9.25 meters, but by substituting an iron casing for the wall the extreme width may be reduced to 7.75 metres. The level of the bottom of the tunnel will be but a little below the normal water level, and it is expected that it will be easy to keep it dry with electric pumps.

HENRY M. WHITNEY.—THE FIRST GREAT ELECTRIC RAILWAY BUILDER.

THE following from the Boston *Beacon* is none too strong. Mr. Whitney deserves every word of praise therein accorded him for his work in endeavoring to give Boston electric rapid transit:—

Mr. Whitney never regarded the monopoly of street occupancy, which he enjoyed, solely as a means to making large profits. He constantly improved the service, enlarged the plant and provided for the accommodation and the comfort of his patrons. Had the West end corporation been a municipal department subject to municipal control and regulation, it could not have been managed with any more regard to the public welfare than it was under his direction.

He retires from the executive management with the respect and gratitude of every public-spirited citizen of Boston. Other men in his position and enjoying his opportunities might have made a vast fortune. Mr. Whitney is poorer than he was before he undertook the great task which he now relinquishes. He has made no money out of the West End, and he has made losses in the direction of bodily health. The strain under which he has worked has been terrific. The physical and mental efforts which he has put forth, the vexations, difficulties and discouragements to which he has been subjected, would have broken down any man who did not possess nerves of steel.

The burden of the work was borne by him alone. His associates in the directory have not been men fit by temperament or capacity to bear their share. He found a hostile force in the Board of Aldermen when he should have found friendship, encouragement and a spirit of coöperation. He sought to benefit the public, to enlarge Boston's residental territory, to improve the facilities for transportation. The people's representatives too often stood in the way and demanded tribute. Carping critics picked flaws in his proposals and sought to create an unfriendly public sentiment. But he persevered to the end and he won. The great system of surface roads which supply the means of travel to millions of toilers is the most complete in the world. It will stand as a monument to his enterprise, energy and intelligence.

ELECTRIC RAILWAY CONSOLIDATION AT NEW HAVEN, CONN.

THE biggest street railroad deal ever made in the State of Connecticut, and indeed in southern New England, was consummated in New Haven last week, when negotiations were completed by which the New Haven Street Railroad Company, an organization granted a charter by the last Legislature, giving it power to absorb any street railroads in the city, which it could buy, completed negotiations and consolidated the State Street Horse Railroad, the Whitney Avenue Road, the Morris Cove Electric Road, and the Lake Saltonstall Electric Road Company, now planning to build a road to Lake Saltonstall. Ex-Governor Waller is the prime mover in the enterprise.

The combined property has been mortgaged for $600,000, which will be expended in extending and improving the roads. They will be equipped with electricity throughout, a new power house being now erected large enough to furnish power for all of them. The company has organized by the election of officers as follows: President, David Corey; secretary and treasurer, George A. W. Dodge; directors, David Corey, G. A. W. Dodge, Thomas Kutz of New York, ex-Governor Waller of New London, J. J. Lawton, Eli Whitney, and William J. Atwater.

ELECTRIC POWER ON A PITTSBURGH INCLINE.

ELECTRICITY as a motive power has been tried on the Nunnery Hill incline. The experiment is highly successful, and it is likely that other inclines will adopt electricity instead of the present system. The movement of the car is very steady, and the sudden jerking incident to the old system entirely avoided. The sharp curve on this incline affords a severe test of the value of the newly adopted motive power, but has proved in every way satisfactory. The incline machinery is operated by two double-reduction 15 h. p. Bentley-Knight motors, coupled direct to the cable drum. It is said that this arrangement gives better satisfaction in every respect than the steam power did. The incline is 1,100 feet in length, 25 per cent. grade, with a curve of about 45 feet radius half way up.

CAR DISTINGUISHING MARKS.

THE question of making easy distinctions between trolley cars all of one pattern and painting, but in operation on different branches, has been one of great interest to street car companies. The Electric Railway Company at Ottawa, Can., is adopting a new device by which the cars on the various routes may be distinguished. Above the head of the motorman a disc will be hung, the cars from the Union depot to the Protestant Hospital bearing a white circle; from the Exhibition grounds to New Edinburgh via St. Patrick street, a red triangle, and cars from New Edinburgh to the Chaudiere Falls via Wellington and Sussex streets, a green square. They will be large enough to be seen at a long distance. It remains to be proved that they will be as distinct at night as by day, which is the main trouble.

ELECTRIC UNDERGROUND TRAVEL FOR NEW YORK.

A SYNDICATE of capitalists, comprising six perfectly responsible men and representing forty-five millions of dollars, has made a proposition to the Rapid Transit Commissioners to build a tunnel and viaduct road from Harlem to the Battery. No aid will be asked from the city, and if the proposition is accepted, work can be begun very soon. The offer will be considered by the commission at its next meeting. Electric motors are contemplated. The necessary consents of the property owners, it is said, have already been obtained.

STREET RAILWAY FATALITIES IN BROOKLYN.

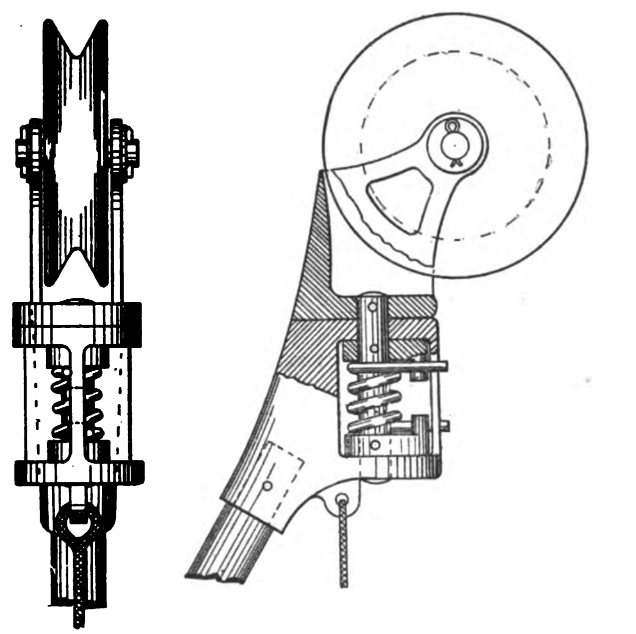
Edward Lauterbach, of this city, appeared before the State Railroad Commissioners in the Brooklyn City Hall last week and argued against the application of the Broadway Railroad Company for the extension of its route and a change from horse to electric traction power. Mr. Lauterbach stated that he represented Messrs. Dane and Hirsch, property owners, but he appeared also in behalf of the Brooklyn Union Elevated Railroad. He argued that the law abolishing the use of steam on the city's streets meant also that there should be no surface rapid transit of any kind.

In support of his argument against the trolley lines, Mr. Lauterbach said that during the period between Jan. 1, 1893, and July 11, the trolley had killed 15 persons, injured 54, and demolished 28 wagons. During the same period the horse cars killed only four persons, injured 37, and demolished only one vehicle. Mr. Lauterbach appeared to be of the curious opinion that these figures, even if correct, proved the greater danger of the trolley.

THE PALMROS TROLLEY.

Mr. Alexander Palmros, of Lynn, Mass., has devised a pivotted trolley which will automatically adjust itself to the circuit wire when going around curved or inclined portions of the latter, or in passing switches, etc., thus preventing the danger of running off the wire.

The device will be understood at a glance by reference to the



Figs. 1 and 2.—The Palmros Trolley.

accompanying illustrations, where Fig. 1 represents an end view of the device and Fig. 2 a longitudinal section partly in elevation. A coiled spring surrounds the spindle and limits its motion of rotation and holds the trolley with a yielding pressure in its central position, preventing it from running off the wire.

TROLLEY CURRENT AND TELEPHONE CABLES IN BROOKLYN.

There was a conference recently on the initiative of Mr. W. D. Sargent, of the N. Y. and N. J. Telephone Company, at the offices of the Brooklyn electrical subway commission, between the commissioners and representatives of the railroad companies in reference to the corrosion of underground wires by the escape of the trolley current. John C. Reilly, the expert electrician and superintendent of the Telephone Company; Electrician Silliman of the Atlantic Avenue Railroad Company; Electrician Starrett of the City Railroad Company; and Colonel Partridge, president of the De Kalb avenue company, were among the conferrees. Professor Plympton, president of the subway commission, says: "The object of the meeting was to determine how this corrosion of the underground cables and the water and gas pipes can be avoided. The data for the consultation was the kind and amount of current that had been detected by the electricians of the Telephone Company in different places where such corrosion had been noticed. The result of the discussion was an agreement to make certain connections with the return wires which may obviate the difficulty. They will keep on experimenting until a remedy shall be found. In some cases telephone cables have been utterly destroyed by the escaping trolley current."

ELECTRIC RAILWAY EARNINGS AT MATTEAWAN, N. Y.

The annual meeting of the stockholders of the Citizens' Street Railroad, of Matteawan and Fishkill Landing, was held Sept. 4th. President Smith presented a detailed account of the receipts and expenditures for the year ending Aug. 27th, 1893, whereby it appeared that after payment of interest and all expenses the company had earned 16 per cent. upon its capital stock of $75,000. A dividend of 10 per cent. was declared, payable Sept. 15th. The road has paid 21 per cent. on the cost.

TROLLEY vs. STEAM IN NEWARK, N. J.

A hot fight is going on in Newark between the Delaware, Lackawanna and Western Railroad Co. and the Consolidated Traction Company, as to a trolley crossing for a new line through Clifton avenue. The steam company objects to the crossing, and the people in the locality threaten trouble unless the trolley project is carried out promptly.

MISCELLANEOUS.

ELECTRIC LIGHTING DEVELOPMENT AT ATLANTA, GA.

Mr. H. T. Edgar, the general manager of the Georgia Electric Light Co., of Atlanta, Ga., which during the recent financial distress placed $25,000 in cash at the disposal of the city treasury, sends us some interesting information about the company's growth, which has been very rapid and creditable. The company, which has a capital stock of $600,000 was formed in 1891, and its circuits now cover the entire city, an area of 10 square miles. The power house which is of brick, not only operates the lighting system but furnishes a large part of the current for the cars of the Consolidated Street Railway Co. The lighting plant is Thomson-Houston comprising four alternators of 6,850 light capacity, 18 arc machines of 50 lights each, and two power generators of 500 volts, of 134 h. p. each. These are driven by two McIntosh & Seymour engines of 500 h. p. each, one Harris-Corliss of 700 h. p., one Green of 800 h. p., and one Armington & Sims of 125 h. p. Steam is furnished by ten Bigelow boilers of 125 h. p. each. There are 112 motors of a total 400 h. p. Mr. H. M. Atkinson is the president of the company, Mr. W. S. Garfield, secretary, and Mr. H. T. Edgar (brother of Mr. C. L. Edgar, the manager of the Boston Edison Co.), general manager. The company's incandescent lighting grows very rapidly. Mr. Edgar writes us: "We now have 8,000 incandescent lights connected, and contemplate purchasing more alternating dynamos to take care of our incandescent load. We expect by the 1st of January, 1894, to have at least 10,000 incandescent lights connected. We also propose on September 1 to organize a motor department and push the motor business for all it is worth. Another thing to which I desire to draw your attention, and which is not generally known, is that the city of Atlanta has not a single gas jet on its streets. They are lighted entirely with electric lights, using 2,000 c. p. arcs, and 75 c. p. Bernstein incandescents burning on the arc circuits. Almost every store in the city has fans running by electric motors.'

AN ELECTRIC JUTE MILL FOR MEXICO.

The *Mexican Trader* states that Mr. Thomas F. Kinnell, the holder of a concession for the establishment of jute factories at Orizaba and elsewhere, has already secured the capital necessary for the erection of the first factory, which will be situated at Barrio Nuevo, Orizaba. The shares amounting in the aggregate to £100,000, have been placed in London. The foundations of the factory have been dug out, and those of the house are being prepared. Work on the canal and tunnel is progressing, and both will shortly be finished. The waterfall at Barrio Nuevo is a very fine one, equaling 11,000 h. p. The factory will be situated 1¼ miles away from, and some 600 feet above the level of, the wheelhouse. Pelton wheels will be exclusively used, and enough electric power generated to drive the machinery. The head-race will be 321 feet in length, and from the head-race the water will be conveyed in pipes to the wheel-house. The fall will be 115 feet. Four dynamos will be used, and every machine in the factory will have a motor of its own, varying from 1 to 20 h. p. This will be the first jute factory in the world driven by electricity. The whole of the electric plant has been ordered in England. The plant has been made specially for the factory. The factory will be built of iron and corrugated iron. The fact that no belting or shafting will be used enables the company to dispense with solid masonry, etc., which would otherwise be necessary, and thus a great saving will be effected. The Santa Gertrudis Jute Mill Company, Limited, by whom the venture is being made, intends manufacturing all articles which can be made of jute, and hopes soon to have its machinery, etc., all erected, so that operations may be commenced with the least possible delay.

DISCUSSION ON MULTIPHASE MOTORS AND POWER TRANSMISSION AT THE INTERNATIONAL ELECTRICAL CONGRESS.—I.

THE discussion on the above subject was opened by DR. LOUIS DUNCAN, who, to begin with, outlined briefly the general principles underlying the operation of alternating motors, assuming as a typical case a two-phase current with a 4-pole motor. In such a machine the conditions were better than in a continuous current motor, because the distribution was such that we could get the current exactly where it was most effective, provided there was no lagging of the current. The latter could be avoided by decreasing the self-induction. This had been done by the Stanley Company, by putting short circuited coils near the armature coil. Another method was to increase the armature resistance and this had also been done by the Stanley Company. There was some difficulty experienced with such motors owing to the prevalence of the upper harmonic current impulses, which reduce the efficiency. There was also the rotary transformer or dynamotor, which could be employed, but the question arose whether, with such apparatus, of say, 100 h. p., the commutator would stand the work.

MR. C. F. SCOTT made a brief statement as to the exhibit of Tesla multiphase apparatus shown by the Westinghouse Company at the World's Fair.

MR. H. C. W. HASSON said he represented, as consulting engineer, a variety of companies in California, who desired to transmit power electrically, aggregating 40,000 h. p., over distances ranging from 10 to 40 miles. Notwithstanding the example of successful transmission for lighting purposes at San Antonio, 28 miles,[1] long-distance power transmission in California, was, he considered, a failure. Exhibition plants afforded no standard of comparison. What was wanted was an installation that could be depended on to run for weeks and months without interruption. The practical plant of this type was still to be evolved.

DR. LOUIS BELL said that in general there were three methods proposed for long distance power transmission, that of the direct current, the single phase and the polyphase. The first had not been a success in this country, for the reason pointed out by Prof. F. B. Crocker.[2] We needed the alternating current because we could do almost anything with it. He did not consider the single phase motor as well adapted to motors as the polyphase, and considered it, at the present stage, as a rather poor polyphase motor. Polyphase systems might be divided into two classes, namely into those having two wires per phase, that is, having independent circuits, and polyphase systems having non-independent circuits. A two-phase system with four wires might fairly be called practical. With three wires it was somewhat simpler. A three-phase six-wire system was prohibitive, but could be worked practically with three wires. All the non-independent circuit polyphase systems save copper as compared with the direct current, the simple alternating or the polyphase systems. With separate circuits the two-phase saved 72 or 78 per cent. and the three-phase 25 per cent., the saving decreasing with the number of phases. Line inductance, he trusted, would not be so serious a matter as it is now, thanks to the work of Mr. C. P. Steinmetz. As to the criticism that polyphase systems with dependent circuits did not regulate well, actual experiment had shown it to be unfounded. It was quite possible so to arrange a dependent circuit polyphase system that the difference between the different branches of the circuit, even under extreme conditions, will be almost intangible, as pointed out by Mr. Steinmetz. The speaker had been experimenting with polyphase motors for a long time and considered them superior to the direct current machines. In all his work he had never yet succeeded in burning out a polyphase motor even under the heaviest strain. He did not agree with Dr. Duncan that such motors took eight or ten times their normal current at starting; they start just about like a shunt motor does. Furthermore, the speed of a polyphase motor could be widely varied, yet keeping practically contant its torque. He denied the accusation that the lagging current in an alternating motor would destroy the regulation of the alternating generator, however well designed, and considered that a polyphase motor that showed a large lagging current at, or anywhere near, full load was a badly designed machine. There was no necessity of having more than 10 per cent. lagging current in any polyphase motor. He had experimented with a 20 h. p. motor in which the lag ranged no more than between 5 and 15 per cent. Besides, the dynamo could be compensated for this amount of lag and he had tried a practical device having in view that object, and had maintained the voltage of the generator constant from no load up to full load.

MR. L. B. STILWELL believed that the exhibit of the Westinghouse Company at the World's Fair marked an advance in polyphase work. It was not an exhibit of toys or models, but of large, working machinery. They were not aiming at a partial, but at a broad solution of the problem; the system shown performed all kinds of service over a single transmission system and from a single generator. It was the duty of the consulting engineer, he thought, to study these methods and to advise their clients accordingly. He did not believe it was the province of the manufacturer to build the apparatus, install it, operate it and guarantee dividends as had been sometimes proposed.

MR. O. FRICK said that in long distance transmission there was no best system. Thus at Genoa the continuous current system was being used successfully up to as high as 6,000 volts Between Lauffen and Frankfort-a.-M., a distance of over 100 miles, 30,000 volts had been used. He had recently seen at the Oerlikon works in Switzerland, a polyphase system operating at 13,000 volts which had been working for 15 months. He had also seen a single phase 100 h. p. transmission in Switzerland in which two h. p. single phase motor was required to start the large one. These single phase motors are built in sizes from 1 to 10 h. p., by Brown, Boveri & Co. They are started as two-phase motors and when running synchronously are put on the main circuit as single phase motors; they do not stop even with overloads of from 50 to 100 per cent.

PROF. S. P. THOMPSON first presented some data from Mr. Thury on continuous current power transmission. Among the Thury plants was one at Geneva, at 1,200 volts constant potential with shunt-wound motors, and another of 150 h. p. at 1,500 volts; still another was of a distance of about 20 miles at 4,500 volts. An installation at Genoa is operated with a constant current of 45 amperes. There are eight generators in series of 1,000 volts each, of 60 h. p., delivering 6,000 volts to the line. The motors were fed by two circuits and varied from 5 to 100 h. p. Speaking for himself, PROF. THOMPSON remarked that the difficulty with the continuous current power transmission at high voltage was not so much at the commutator but was to be looked for in the electrolysis of the insulating surfaces of material when exposed to moisture. This danger was not so much to be apprehended with the alternating current. As an example of continuous current power transmission he referred to the Oxford, England, system in which current brought in at 1,000 volts is converted and distributed at 100 volts by means of dynamotors. The installation worked very well. The speaker also drew attention to the alternating current installation at Rome which he deemed well worthy of study. He agreed with Mr. Frick that there was no "best system;" to acknowledge such would be equivalent to saying that some one had invented the best steam engine. One would want to know what that steam engine was best for, whether it was suited for a mill or a threshing machine, whether for a large factory, or a steamboat or a locomotive. Looking at the polyphase system, he did not love the complication of three-phase transformers and switchboards, etc. The three-phase and two-phase dynamos and motors were beautiful and a great many things could be done with them. For all distribution systems, as distinguished from transmission systems, he believed that polyphase work would be abandoned, and that we would return to the simple alternate current methods. He ventured to predict that the simple alternate current work would be the thing which, 10 years hence, would be found effective for distribution at the customers' end. In England they were trying to reduce everything to the simplest type, and the results achieved were excellent, and while admiring the ingenuity exhibited in the drawings of apparatus shown by Mr. Scott he thought that something simpler would prove successful in the future.

PROF. GEORGE FORBES agreed with Prof. Thompson that each type of transmission had its own sphere of action. While the continuous current could be used for transmission at a distance, it possessed none of the beauty of the diverse applicability of the alternating current. There was trouble at the commutator and in insulating the armature, which must be the revolving part. In the alternating generator the armature might be stationary and insulated with oil if necessary. The continuous current rotating transformer was not to be compared with the alternating transformer. The speaker had had very long experience with synchronizing alternating machines used as motors and had a very high opinion of them, but they were only applicable in cases where power is required constantly; but where required to start, stop and reverse, the synchronizing system was practically out of the question. So far as he had studied the polyphase systems, and he had given them a great deal of personal and practical study, he considered the two-phase system the better. The three-phase introduced complications by the inter-connection of the three conductors; it introduced trouble in locating the circuit and in testing, and in correcting faults which might arise. He preferred a two-phase system with separate independent circuits, which were more easily managed, tested and regulated. Moreover, when the three circuits are inter-connected each one had an influence on the other and the unbalancing on one side of the circuit greatly affected the others. Thus, if in a three-phase system circuit A be overloaded and B and C not loaded, then B might be at a higher voltage than A; but C would have a higher voltage than either of them. This was a fact not generally known and was a serious drawback to the use of the three-phase system, condemning it for lighting purposes. Prof. Forbes had advised the Cataract Construction Co. to reject the three-phase system and to build their first dynamos with two-phases because he believed that

1. For a full description of this installation, see THE ELECTRICAL ENGINEER, page 98, Aug. 2, 1893.
2. See page 237 of THE ELECTRICAL ENGINEER, Sept. 6, 1893.

in this manner those dynamos could be used in every direction in which alternating current transmission would be developed in the next ten years. The two-phase system had the advantage not only of being able to work two-phase motors, but, as it gave two singe-phase circuits it would be able to work all the single-phase machinery which would ever be invented in the future; besides, a dynamo constructed on the two-phase plan would give the single-phase cheaper than if it were constructed with one circuit.

MR. CHARLES P. STEINMETZ referred to the many thousands of horse power used to propel street cars, which showed that the continuous current was not dead yet. With regard to the polyphase and single alternating current, it made no difference how many phases were used because any polyphase system could be transformed into any other by using only two transformers. He was of the opinion that the system of the future would be the single phase. They would, by proper appliances, abolish the effects of self induction in the machine, and capacity in the line. In a continuous, constant current for arc lighting, or any other use, we were perhaps nearer to this ideal condition than we might think.

PROF. GEORGE FORBES. I feel that it is a very fitting time that one should say a few words about the condition of affairs at the present moment in the way of utilizing the Falls of Niagara. A great deal of time and thought has been given to selecting the best system to be adopted for this work, and for a long time the question was open whether the power should be used directly by wheel pits communicating with each separate mill that was going to take the power. It was a resolution of the deepest importance which was arrived at by the President of the Cataract Construction Company when, after having inspected all that was being done in Europe and knowing all that was being done in America in the way of transmission of power, he telegraphed to the New York office that it must be a question of starting central stations at the Falls of Niagara. That was the first step that was taken. The question was whether the power should be transmitted by compressed air, by rope transmission or by electricity, and I may say that for a long time there was a great preponderance of opinion in favor of compressed air. Finally we have all to congratulate ourselves that the resolution was adopted to do the whole of the transmission by means of electricity.

In the year 1890 a number of plans were invited from different engineers and manufacturing firms as to the best means of utilizing this power. These plans were submitted before an international congress consisting of members well known in the engineering and electrical world of all countries, who met in London at the beginning of 1891. At that time there was one report which used these words: "It will be somewhat surprising to engineers in general as it was to myself to find that the only possible means of transmitting this power to Buffalo and the best means for using it in the neighborhood of the Falls is by means of the alternating current." I made that statement in my report after having considered carefully every means which was then available. I am glad to say that I have never had any reason to change my opinion from the year 1890 to the present day. I proposed then that the work should be done by alternating currents generated in two phases; that these should be sent along separate circuits at high voltage; that the transformers should be used for reducing the pressure down and introducing a safe pressure into the workshops; that in the workshops synchronizing alternating motors should be used in some cases, and that in other cases two-phase motors should be employed, and that in the cases where the direct current was necessary, alternating motors should be used to drive continuous current dynamo machines. That was in the year 1890, and in the present year, 1893, there is hardly a change to be made upon that system which has been proposed.

I mentioned yesterday the chief considerations objectionable in the use of continuous currents for the transmission of power at Niagara Falls. There are many cases where the continuous current is the most desirable to use for transmission of power, and the chief disadvantage is the necessity of putting all your motors in series at the receiving end of the line. But in all these cases that come before the practical engineer, the most important thing to consider is the question of cost. At every stage of the working out of the scheme the cost is really the thing that governs the engineer most of all, and it is fortunate when we find that the best harmonizes with the cheapest, as sometimes happens in great engineering works, and as I am glad to say, it has happened in the case of this great work of the utilization of Niagara Falls. After the Congress closed its labors and when electricity was decided upon for the purpose, projects were asked for from all the greatest firms in the world. They were asked to submit plans for dealing with this problem. Some were continuous current and some were alternating current. The greatest difficulty was experienced in nearly every case by those who were proposing continuous currents to meet the requirements in any way whatever, and in every case the cost was largely in excess of the cost with alternating currents. One of the things which we have decided upon is that we are to use the same system for the distant transmission as we are to use for the near-by transmission. Nearly all, when they have begun to tackle this problem, have thought that it was desirable to use a lower voltage for the near-by transmission. One or two thousand volts seemed to be about right when you were only transmitting a distance of a mile or two, whereas 10,000 or 20,000 volts was considered nearer right for the distant transmission. But the advantages which we gain by using the higher pressure to a great distance are also gained in using the near-by distribution. Moreover, in all these cases it is almost impossible to grasp the full conditions of the problem until you come down to the details. Suppose you do start with 1,000 volts for a distribution say of the first 50,000 h. p. in the neighborhood of the Falls, you will find that the mass of conductors that you have to deal with is something simply impossible. The most convincing argument that I was able to adduce on this point was by drawing a full scale section of a subway carrying the conductors which would be necessary at 50,000 h. p., and it filled a large subway through which a man could walk. It filled that subway up with conductors in such a way as to show, without any further demonstration, that it was unpractical. Moreover, the simplicity of having the whole of the system all in one voltage is something which cannot be overestimated, and this is the way in which we propose to work.

I am glad to feel that the universal opinion is in favor of the adoption of alternating currents. I can only quote one man of any eminence who seriously and persistently considers that it is the greatest mistake to use the alternating current for such a purpose. I will not mention that gentleman's name, and it is a very well known name, one that bears the greatest influence; so great an influence that I and those with whom I have been associated have considered with the utmost care every single point in the matter before rejecting the advice that has been given us. The opinion was stated in a general way, but the concrete way in which it was put by this authority was that on the top of our vertical shafts which come from the turbines we should have a building four stories high, for each turbine. Each floor should be insulated completely from the rest of the building. At each floor there should be a large toothed wheel driving five other toothed wheels, on each one of which should be a dynamo of vertical shape. We should thus have 20 dynamos, each of 1,000 volts, all continuous current dynamos, all connected in series. That plan we have considered most carefully, owing to the source from which it came, and we have rejected it. We are now going ahead with the alternating current, and at every point the question of cost has been considered, and the results which we have arrived at I believe are the best, and I may also say that they are certainly the most economical.

In the year 1890, at the time that I proposed the adoption of synchronizing alternators in some cases and Tesla motors in other cases, there were comparatively few who had much experience with either one or the other of these alternating motors. The Tesla motors I had fortunately been able to see at the Pittsburgh works of the Westinghouse Company, and they had been placed at my disposal for experiments, and I put a high value on the outcome of these motors and what they would be developed into. I regret to say that during the intervening years there was very little done in the way of developing these Tesla motors at Pittsburgh. In the meantime the question was being taken up in other countries, and in Europe at the time of the Frankfort exhibition there was a great deal of multiphase work shown in action. This directed the attention of the world to it, and I am glad to say now that in America also the multiphase motors have made progress. Prof. Silvanus Thompson said yesterday that he thought multiphase motors would disappear from general distribution, and that the single phase motors with a multiphase means of starting the motor might be the more universal way adopted. That is one of the possibilities of the future. There are several possibilities of the future that we must consider in any very great scheme like that which I am speaking of at the present moment, but in the meantime we must deal with the possibilities of the present. I consider that the multiphase motors at the present moment are not only a possibility, but are a valuable adjunct to the other uses for which the alternating current can be used. Now, a great part of the work in any large system of distribution like that is the continuous working, day and night, or from early morning till late night. A mill is started in the morning and never needs to be shut off during the day, and there are other mills of a character most likely to be attracted to such a situation which run day and night, from week's end to week's end. The largest consumers of power which we have at present are the pulp mills for making wood pulp for paper, consuming thousands of horse power, and next to these come the electric deposition works, where power is required from week's end to week's end, continuously running. In these cases, if it is simply power you require, a synchronous motor is admirably adapted and thoroughly satisfactory, but in all ordinary workshop practice where we wish to be stopping, starting and reversing our machinery, the most convenient alternating motor, which is a thing, not of the future, but ready for practical use at the present moment, is the multiphase motor. It is possible to do without the multiphase motor perfectly well, but it is a valuable adjunct at the present moment.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED AUGUST 29, 1893.

Alarms and Signals:—

Fire Signaling or Alarm Mechanism, L. J. Tirard, Caen, France, 504,009. Filed June 24, 1893.

A simple and inexpensive automatic fire alarm.

Electric Indicator, J. L. Bradley, St. Louis, Mo. Filed Feb. 4, 1893.

Designed to register and signal the exact floor of a building where a fire exists and also to signal a breakage of a wire or a weakness of the battery.

Conductors, Conduits and Insulators:—

Insulator, G. W. Blackburn, Palmyra, N. J., 504,059. Filed Aug. 30, 1892.

Employs a clamp for holding the line wire in place similar in its action to that employed on patent bottle stoppers.

Dynamos and Motors:—

Brush for Dynamos and Electric Motors, F. H. Sandherr, St. Louis, Mo., 504,177. Filed Jan 7, 1893.

A brush in which the contact with the commutator is rolling instead of sliding.

Regulator for Dynamic Machines, J. C. Henry, New York, N. Y., 504,216. Filed April 29, 1892.

Claim:

The combination of a power transmitting gearing, consisting of a gear and pinion held to intermesh, but one free to rotate about the other, belt and pulley connected to and adapted to drive one of said members, and a regulative device connected to the free member of the gearing.

Galvanic and Thermo-Electric Batteries:—

Electric Battery, H. W. Libbey, Boston, Mass., 504,130. Filed Sept. 15, 1892.

Consists of two outer plates of insulating material, a central ring of insulating material, two plates forming the positive and negative elements, an absorbent material between the plates and means for supplying the exciting fluid to the absorbent material.

Lamps and Appurtenances:—

Manufacture of Carbon Rods for Electric Arc Lamps, E. Corleis and H. Renisch, Essen, Germany, 504,105. Filed April 26, 1893.

A carbon impregnated with tungstic acid or a salt of this acid.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 504,271. Filed June 9, 1893.

Employs a feeding rod with two carbon holders combined with a single electric regulator designed to intermittently feed the rod in the ordinary way.

Electric Arc Lamp, W. A. Phillips, United States Army, 504,277. Filed June 3, 1893.

Employs circular carbon holders and wheels intergeared therewith, an electric magnet and armature to engage the wheels as a brake and release therefrom by the action of the magnet.

Metallurgy:—

Art of Concentrating Magnetic Iron Ore, G. Conkling, Glens Falls, N. Y., 504,200. Filed Sept. 30, 1891.

Art of Concentrating Magnetic Iron Ore, G. Conkling, Glens Falls, N. Y., 504,201. Filed Jan. 16, 1893.

Apparatus for Melting Iron, S. Shaw, Milwaukee, Wis., 504,282. Filed Aug. 24, 1891.

A cupola furnace having flues leading from the lower portion back into the ore chamber and electrodes automatically producing an arc between the ends of the flues.

Apparatus for Melting Iron or Iron Ore, S. Shaw, Milwaukee, Wis., 504,308. Filed Nov. 14, 1891.

Similar to 504,282.

Miscellaneous:—

Electric Bowling Alley, P. P. Nelson, New York, N. Y., 504,087. Filed Sept. 21, 1892.

Electric Clock, E. Schweizer, Sumiswald, Switzerland, 504,095. Filed July 16, 1892.

Railways and Appliances:—

Means for Transmitting Power from Car Axles to Dynamos, M. Moskowitz and S. Young, Newark, N. J., 504,182. Filed April 29, 1893.

Signaling Apparatus for Railways, J. Orme, London, Eng., 503,981. Filed Dec. 6, 1892.

Has for its object to operate by means of a closed electric circuit of alternate directions a block signal system for steam railways.

Electric Circuit for Controlling Trains, F. E. Kinsman, Plainfield, N. J., 504,042. Filed Jan. 11, 1893.

An electric block system for steam railways designed to automatically control the trains.

Electric Conduit for Railways, J. L. Conklin, Brooklyn, N. Y., 504,104. Filed May 2, 1892.

A system in which a main and a second conductor are employed, normally out of contact with one another but the latter adapted to make contact with the former by being pressed against it by the trolley wheel.

Electric Railway Trolley, A. Palmros, Lynn, Mass., 504,113. Filed Sept. 1, 1892.

The wheel is pivotted at the end of the floor in such a manner that it may automatically adjust itself at curves, switches, etc. (See this page).

Electric Railway Trolley, F. J. Sprague and P. F. O'Shaughnessy, New York, N. Y., 504,255. Filed Jan. 19, 1889.

Employs a coiled spring on a vertical axis for supporting the trolley pole.

Crossing for Electric Railways, J. Nelson, St. Louis, Mo., 504,276. Filed May 18, 1836.

Consists of a central plate in which the lower wire is seated and to which are attached bars of insulated material carrying separate ears for attachment to the upper wire.

Switches and Cut-Outs:—

Circuit Switch, C. E. Dey, Denver, Col., 504,123. Filed Dec 13, 1892.

A push-button switch for light or bell circuits.

Push-Button, W. H. Berrigan, Jr., New York, N. Y, 504,148. Filed April 7, 1892.

A push-button made entirely in one piece stamped out of a single sheet of metal.

Rheostat, A. B. Herrick, Schenectady, N. Y., 504,160. Filed July 22, 1892.

Arranged to progressively decrease the resistance by a movement of the handle in one direction, and by a further movement in the same direction to first suddenly introduce a high resistance and afterwards break the circuit.

Telephones and Apparatus:—

System of Telephonic Intercommunication, F. R. Colvin, New York, 504,103. Filed Feb. 6, 1893.

Makes provision whereby any one of a number of stations may at will place itself in direct communication with any other station of the system without the intervention of a central station. (See this page).

Multiple Switchboard Keyboard Apparatus, C. E. Scribner, Chicago, Ill., 504,249. Filed Dec. 6, 1887.

Has for its object to afford ready means of closing a telephone through the operator's line when the plug is lifted, and the normal ground removed.

Telephone Exchange Testing Apparatus, C. E. Scribner, Chicago, Ill., 504,250. Filed June 1, 1889.

Consists in the arrangement of circuits to include the subscriber's telephone battery in the circuit of the line when the telephone is off the hook while the same battery also serves to operate the transmitter and induction coil of the subscriber's set.

Vibrating Circuit Breaker and Retardation Coil for Test Systems, C. E. Scribner, Chicago, Ill, 504,251. Filed March 4, 1891.

PATENT NOTES.

AN INTERESTING TELEPHONE DEVICE—NEW UTILIZATION OF THE RECEIVER HOOK.

EVERY one at all familiar with any kind of telephone service knows what a multiplicity of devices has been invented, particularly in the earlier years of telephony, for connecting to line and disconnecting the telephone. Most of the valuable inventions of the kind have found their way into the huge collection of patents owned by the American Bell Telephone Company and the Western Electric Company.

Mr. F. R. Colvin, of New York, has recently patented (August 29) a very interesting switching or connecting device, in connection with his intercommunicating telephone system. He simply uses the contact between the metallic ring, by which the telephone is suspended when not in use, and the hook upon which it is hung, to short circuit or shunt the transmitter and receiver. The instruments are, of course, immediately put in circuit by the removal of the receiver from its hook. The second claim of Mr. Colvin's patent is as follows:

"In a telephone system the combination of the main circuit and a portable telephone having one of its terminals provided with a metallic extension mounted on the instrument, and the other in electrical connection with a metallic support upon which the telephone may be hung, the two terminals leading to opposite sides of the circuit, whereby, when the telephone rests on the support, it is short circuited, but when removed therefrom the short circuit is open."

Although it sometimes seems that all conceivable ways of accomplishing a given result have been found, Mr. Colvin's device is so simple and obvious that one wonders why it was not employed and patented long ago by some of the very clever inventors of telephonic apparatus.

A SPRAGUE TROLLEY PATENT.

A PATENT has just been granted to F. J. Sprague and P. F. O'Shaughnessy, assignors to the Sprague Electric Railway and Motor Company (General Electric Company) for improvements in trolley pole and contacts. The application was filed January 19, 1889, and the patent as issued contains no fewer than 28 claims. The leading feature of the invention is the now familiar use of a spring coiled on a vertical axis for supporting the pole, furnishing thus a universally flexible support which opposes any deflection in any direction from the vertical, so that the trolley wheel adapts itself to all the variations in the line's elevation, etc., and is at the same time kept firmly pressed against the wire. The claims cover a number of details more or less related to the main idea embodied in the principle resorted to, including poles in sections of different diameters, guides for the trolley wheel, sockets on the car roof, etc.

LETTERS TO THE EDITOR.

THE STANLEY-KELLY ALTERNATING MOTOR.

IT would save a vast amount of time, now wasted in discussion, if disputants would begin by assuming that the other side knows something and is not entirely devoid of common sense. Probably this, however, is too much to expect of academic gentlemen when the people on the other side happen to be mere engineers. As a case in point, take Dr. Louis Duncan's address at the Chicago Congress. He tells his audience that it is questionable if, in the alternating current motor built by the Stanley Electric Manufacturing Co., any advantage is gained from the short-circuited coils used to neutralize the self-induction of the armature, as these coils displace so much valuable iron. Now it so happens, and any common man would have assumed as much, that at first we tried to build the motors without compensating coils and the results were so unsatisfactory that we were driven to use them. We know, as well as practical men can know anything, that these coils are of enormous advantage.

JOHN F. KELLY.

THE STANLEY LABORATORY COMPANY,
Pittsfield, Mass., U. S. A., Sept. 8, 1893.

THE BRUSH COMPANY IN CANADA.

THE Moncton, N. B., *Times* refers to a report that the Brush Electric Company may start a factory in the Maritime Provinces, and probably at St. John, N. B. Col. W. S. Rogers, of Cleveland and Mr. G. F. Calkin, of St. John, have the matter in hand.

LAMP TESTS AT THE WORLD'S FAIR.

PROF. B. F. THOMAS, chairman of the Sub-committee 4, of the Committee on awards, has given out the following authoritative statement as regards the testing of incandescent lamps at the World's Fair.

The lamps entered in the test are as follows:

Edison lamp, 50 v. and 110 v., and Thomson-Houston lamp, 50 and 110 v., entered by the General Electric Co.

Novak lamp, 50 v. and 110 v., by the Waring Electric Co.

Packard lamp, 50 v. and 110 v., by New York and Ohio Co.

Stopper lamp, 50 v., by the Westinghouse Electric and Mfg. Co.

The number of lamps of each make is limited to 40 of each voltage, or 80 of each make, except the "stopper" lamp of the Westinghouse Co., which enters simply as a 50 volt lamp.

The manner of testing that has been decided on by the committee, and agreed to by the competitors, is as follows:

Lamps entered for award shall be subjected to a test whose object shall be to determine the mean horizontal candle power, the efficiency and life, and the blackening of the lamps entered, at proper intervals during the time covered by the test.

Current Supply.—The Fort Wayne Electric Company has placed an engine and all dynamo machinery necessary at the disposal of the Committee. This machinery will have nothing to do except to supply current to the lamps under test. 110 volt lamps will be supplied with direct current and 50 volt lamps with alternating. Lamps will be placed on racks, on circuits of heavy copper rod, all lamps of a given voltage being on one circuit. Careful provision will be made to maintain voltage constant.

Standards.—The English sperm candle for candle power. Electrical standards as agreed upon by the sub-committee on instruments.

Instruments.—For candle power measurements, a Lummer-Brodhun photometer, length of bar, 250 cms., Methven screen, using carburetted gas—gas to be filled with gasoline distilled between 35 and 50 degrees C., from 90 degree gasoline. The electrical instruments used will be Weston instruments, which will be tested at the beginning of the test, and at intervals during its progress by Sub-Committee (1) on instruments, etc. Recording voltmeters (if such can be obtained) will be placed on the life test circuits.

Scheme of Test.—The photometer being properly mounted, the Methven screen will be tested by comparison with standard candles. This test being satisfactorily completed, two or more 32 c. p. lamps, of proper voltage carefully selected with reference to uniformity of radiation in a given direction, will be tested at standard voltage. One of these lamps, so measured, and thereafter designated as working standard, will be placed on the photometer. Each lamp entered for test will then be compared with the working standard, both being carefully adjusted to standard potential. The mean horizontal intensity of each lamp will be obtained, preferably by spinning, when under comparison with the working standard, which latter will be maintained at about 16 c. p. The candle power of each lamp in a marked position (azimuth) will also be determined at the same time, and its "position factor" derived. At the same time that the photometric work is done on each lamp, careful reading of potential and current, or of potential and watts, will be taken. A storage battery of proper size will be used to furnish current to all lamps when under photometric tests, and rheostats and switches in connection with the battery so that the lamps may be run at the exact voltage intended.

After the initial measurements are made, the lamps, each tagged, or otherwise marked with an individual number, will be placed on the rack. The rack or rack section being filled, switches will be closed, time noted, potential carefully adjusted, and maintained constant.

At intervals (as small as convenient in the earlier days of the life test) each lamp will be removed from the test rack, placed on the photometer in its "marked position," and readings of candle power, voltage and current (or watts) taken. Complete records of all things affecting the tests or results will be kept in proper blank books.

Results.—The data of the test will be completed and tabulated, and curves will be drawn, so as to show the following points:

(1) Mean horizontal candle power, and percentage of initial candle power, at each reading throughout the test.

(2) Efficiency (watts per candle power), at each reading.

(3) Time of breaking of each lamp broken.

(4) Average cost of a candle-power hour of light produced by each make of lamp at intervals during its life, such cost to include cost of lamp and cost of energy required to operate it. Separate curves will be prepared for the average of each make, giving the above cost under varying conditions, varying from 15 to 50 cents for cost of lamp, and from 10 to 25 cents for cost of 1,000 watt-hours of energy.

Report.—A report upon the test giving a full account of all points concerning the methods and instruments used, details of machinery and circuits, all original readings, etc., will be formally made to the proper official of the Exposition, with the recommendation that it be printed at the earliest possible date. If prompt printing is not found possible, permission to give the report to the electrical press will be asked.

The test will continue until October 1, running 24 hours per day, and if at that time it seems desirable to continue the run, the committee will endeavor to secure such continuance.

With the exception of "spinning," the above scheme is acceptable.

(Signed.) JOHN W. HOWELL, for Edison General Electric Co. and Thomson-Houston Electric Co.; F. A. BAUX, agent the Waring Electric Co.; E. E. KELLER, manager and general superintendent Westinghouse Electric and Manufacturing Co.: T. S. GASSAWAY, for New York and Ohio Co.

Power is supplied by a 150 h. p. Buckeye engine located in the space of the Fort Wayne Electric Co., Machinery Hall. This engine drives a Fort Wayne 500 volt power generator, from which a separate circuit runs to the exhibit space of that company in Electricity Building, connecting there with a 125 h. p. 500 volt motor. This motor drives a countershaft to which a 110 volt direct current dynamo of the Fort Wayne type, and a 1,000 volt alternator are connected. From these two generators mains lead under the floor to the test room in the southwest corner, ground floor of Electricity Building.

At the switchboard in the test room are provided main switches controlling each a lamp rack. There are five racks in position. Nos. 1 and 2 are connected up for a 50-volt alternating circuit joined to the secondaries of Thomson-Houston transformers at the switchboard. Racks 3 and 4 are used for the 110 volt direct current circuit.

The connections from the switchboard to the racks, and the mains upon the racks themselves, are all made with very heavy copper wire, practically No. 0000 wire, supplied by the Ansonia Electric Co. All connections are made in such a way as to insure practically the same potential at the terminals of every lamp on the rack.

There are also special circuits leading from the generators to the switchboard in the test room by which rheostats are placed in the field circuits of both the direct and alternating generators so that the attendants in the test room are able to control and adjust, when necessary, the voltage at the lamp racks.

Potential indicators are placed on the switchboard for all the circuits, and also Weston voltmeters for the exact adjustment of potential. Bristol recording voltmeters are also attached for the purpose of recording any variations in voltage which may occur.

A special three-wire circuit is run from the American Storage Battery Co's exhibit to the switchbord and photometer in the test room. Whenever photometer readings of lamps are taken, the lamps are supplied with current from this battery, the three-wire connection being such as to give either 50 or 110 volts, as desired. A special arrangement of rheostats in the storage circuit makes it possible to adjust voltage to any desired degree of accuracy.

The tests were commenced Friday, Sept. 8, and will be continued twenty-four hours every day—except Sundays—Until Oct. 31st, and possibly later.

Photometric readings of lamps are taken for the first time after they have been on the rack 10 hours, then at the following intervals: 20, 20, 50, 50 and 100 hours.

SOCIETY AND CLUB NOTES.

THIRD ANNUAL MEETING OF THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

THE third annual meeting of the American Electro-Therapeutic Association was held at Apollo Hall, Chicago, on Sept. 12. Reports were made by committees on standard coils, standard meters, static machines, constant current generators and controllers, electrodes, etc.

Following the reports a number of interesting papers were read, and in the evening a reception was held at the Great Northern Hotel.

At the closing session, Prof. W. J. Hedman, of Ann Arbor, was chosen president for the ensuing year; Dr. Franklin H. Martin, of Chicago, first vice-president; Dr. A. Lapthorn Smith, of Montreal, second vice-president; Dr. R. J. Nunn, Savannah, treasurer; Dr. Margaret Cleaves, New York, secretary. The Executive Council is composed of Dr. Augustin H. Goelet, New York; Dr. W. J. Morton, New York; Dr. G. Betton Massey, Philadelphia; Dr. Robert Newman, New York; Dr. C. R. Dickson, Toronto. A committee was appointed to investigate electrical illuminators for therapeutic and diagnostic purposes. Several papers were read and a variety of new electrical apparatus for medical purposes was exhibited.

After the reading of the paper scheduled for the evening programme, a short business session was held, at which it was decided to hold the next meeting of the association on the last Tuesday in September, 1894, in New York City. The convention was then closed by a speech by the outgoing president, Dr. Augustin H. Goelet of New York, and the formal induction into office of the president for the ensuing year, Dr. W. J. Herdman.

THIRD CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION AT TORONTO, SEPTEMBER 12, 13 AND 14, 1893.

THE third convention was opened at 2.30 P. M., September 12, in the Board Room of the Industrial Exhibition Association, Toronto, by the President MR. J. J. WRIGHT, who, in delivering his address, congratulated the members upon the progress that had been made by the Association and upon the success which had attended their efforts for the advancement of the interests of the electrical fraternity. With regard to the great advance that was being made in the employment of electricity, he said, that, apart from the rapid increase in what might be termed its standard uses, the most notable development appeared to be in the field of alternating currents, especially of a higher tension than had hitherto been deemed practical or advisable. With the advent of a successful alternating current motor, the use of this system would increase still more in the near future.

He expressed the hope that the association would determine upon and indorse a standard of illuminating power for arc lamps; one that would be recognized in Canada, at least, as authoritative and would be referred to as the Canadian Electrical Association standard. If the association accepted nothing but the ideas of others, it might as well cease to exist and let other people think for it. In concluding he referred to the Hurontario canal scheme, by which it was proposed to construct a ship canal between Lakes Huron and Ontario and to utilize its water power for electric light and power. The project was dealt with humorously, in a spirit of mild satire, the speaker regretting that more details were not forthcoming, as to the methods of combining the various uses to which the canal and its power were to be put, so that the public should not be compelled to speculate as to how it was all to be done.

MR. C. H. MORTIMER, the secretary-treasurer, then presented his report in which he referred to the bill for the inspection of electric lighting, which was introducted at the last session of the Dominion Parliament but was withdrawn by the Government through the instrumentality of the president of the Association and Mr. A. B. Smith, who pointed out that some of the provisions of the bill would render its operation too burdensome to electric light companies. The report showed that during the past year the membership had increased from 107 to 138 and that the financial condition of the Association was on a good basis, there being a balance on hand of $275.00.

The Committee on Statistics, which had been appointed at a previous convention to collect statistics of the electrical industries, submitted a report, but as it was incomplete, the committee asked for an extension of time for its completion, which was granted. It was decided that the report should not be given to the press for publication until fully completed.

Two interesting papers were then read, one on "Some of the Causes of Interruption to Telegraph Circuits" by MR. FRED C. ROBERTSON, of Toronto, and the other on "Water Wheels," by MR. A. C. MCCALLUM, of Peterboro.

The session on Wednesday began at 10 a. m., with the president in the chair. The following papers were read, after the transaction of some unfinished business: "The History of the Telephone in Canada," by MR. L. B. MCFARLANE, of Montreal; "Electrical Education," by MR. E. B. MERRILL, of Toronto; "Direct Connected Dynamos and Steam Engines," by MR. JOHN LANGTON, of Toronto; "Electric Street Railways," by MR. E. CARL BREITHAUPT, of Berlin, Ont.

The following officers were elected: President, J. J. Wright, manager Toronto Electric Light Company; first vice-president, K. J. Dunstan, local manager Bell Telephone Company, Toronto; second vice-president, John Carroll, secretary-treasurer Eugene Phillips Electrical Works, Montreal; secretary-treasurer, C. H. Mortimer, publisher *Electrical News*, Toronto. Executive committee: A. B. Smith, superintendent construction G. N. W. Telegraph Company; J. Yule, manager Guelph Light and Power Company; D. Thomson, Hamilton; T. R. Rosebrugh, School of Practical Science; Geo. Black, Toronto; H. O. Fisk, Peterboro Light and Power Company; L. B. McFarlane, Bell Telephone Company, Montreal; E. C. Breithaupt, Berlin; and T. Ahearn, Ottawa.

It was decided to hold the next meeting at Montreal next fall during the week of the local exhibition which is held there.

Thursday was spent most pleasantly in an excursion to Niagara Falls and vicinity. The members went by steamer to Queenston, thence by electric car over the Niagara Falls Park and River Railway to Chippewa, on invitation of the manager of the railway, Mr. W. A. Grant. The power houses and plant of this interesting railway, recently described in detail in THE ELECTRICAL ENGINEER, were visited and inspected. By invitation of Capt. Carter, superintendent of the Niagara Falls Electric Light and Power Company, a trip was taken on the steamer "Maid of the Mist" and the works in the tunnel district visited.

There was a good attendance of the members at the convention, among those present being: Messrs. J. J. Wright, president; C. H. Mortimer, secretary, Toronto; K. J. Dunstan, Toronto; C. H. C. Wright, Renfrew; L. B. McFarlane, Montreal; B. J. Thorp, Hamilton; F. Thomson, Montreal; John Galt, Toronto; M. J. Fraser, Petrolia; A. B. Smith, W. A. Towers, F. Nicholls and J. H. Armstrong, Toronto; R. Black, Hamilton; E. B. Murphy, T. R. Rosebrugh, F. C. Robertson, W. A. Johnson, Hugh Neilson and J. H. Kammerer, Toronto; John Carroll, T. W. Ness, Montreal; George Black, Hamilton; John Yule, Guelph; A. C. McCallum, Peterboro; E. C. Breithaupt, Berlin, and John Langton, Toronto.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE 79th meeting of the Institute, and the first of the present season, will be held at 12 West Thirty-first street, on Wednesday, Sept. 20, at 8 o'clock, p. m. President Houston will deliver his inaugural address, the subject being "The Chicago International Electrical Congress." A paper will also be presented by Mr. D. McFarlan Moore, of the Engineering Department, General Electric Company, on "A New Method for the Control of Electric Energy." Those who are especially interested in the subject may obtain advance copies by addressing the secretary. The Council has voted, that until further notice the monthly meetings will be held on the third Wednesday, instead of the third Tuesday of each month, as has been the practice heretofore.

OLD-TIME TELEGRAPHERS.

THE thirteenth annual session of the Old-Time Telegrapher's Association and the United States Military Telegraph Corps was held last week in the Great Northwest Hotel, Chicago. President W. R. Plumb opened the session with a short address of welcome. The following officers were elected for the ensuing year: president, W. R. Plumb, Chicago; vice-president, W. H. Wilson, Philadelphia; secretary and treasurer, J. E. Pettit, Chicago. The members visited the Fair and concluded their session in the evening with a banquet at the hotel.

PERSONAL.

AMONG the passengers of the new steamship "Lucania" was Mr. Thomas G. Clayton of Derby, Superintendent of Construction of the Midland Railway of England. He comes as the guest of his brother, Mr. James Clayton, president of the Clayton Air Compressor Works, New York, and while here will visit the World's Fair and make a study of the railway systems of this country.

PROF. SILVANUS P. THOMPSON. on his way home to England from Chicago, spent the past week in New York making a rapid but close study of all the electrical engineering work of any importance in central stations, power houses, etc. He took the opportunity to visit some of the electrical factories in the suburbs.

HON. J. D. REID, U. S. Consul at Dunfermline, Scotland, has in a recent issue of Consular Reports a very interesting report on flax culture, an industry of great importance to the town at which he officiates. The hand that wrote the history of the telegraph in America has not lost its skill.

OBITUARY.

F. L. AMES.

THE death occurred suddenly last week on the Boston boat of Mr. Frederick L. Ames, one of the richest and most active public men in New England. His wealth is estimated at over $25,000,000. He was a director in the Western Union and General Electric companies, and heavily interested in both. The news of his death was followed by a temporary weakness in the quotations of General Electric stock, but the rally was quick.

THE NEW YORK ELECTRICAL WORKS.

THIS company, of 161 Washington street, this city, manufacturers of all kinds of line materials for electric railways, have been doing excellent work during the dull times. Among the roads using their materials may be mentioned the Brooklyn Heights Railway Company, the Philadelphia Traction Company, the Cleveland (O.) Cable Company, the Camden and Gloucester Railway Company, the Brigantine Transit Company, Atlantic City, N. J. and the Olean (N. Y.) Street Railway Company.

ANSONIA ELECTRIC CO.

THE ANSONIA ELECTRIC Co. has resumed work at Ansonia, Conn., under the management of the receivers. Wages have been reduced from 8 to 10 per cent. on unskilled labor and about 15 per cent. on all other grades. The business outlook of the concern is regarded as very hopeful.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

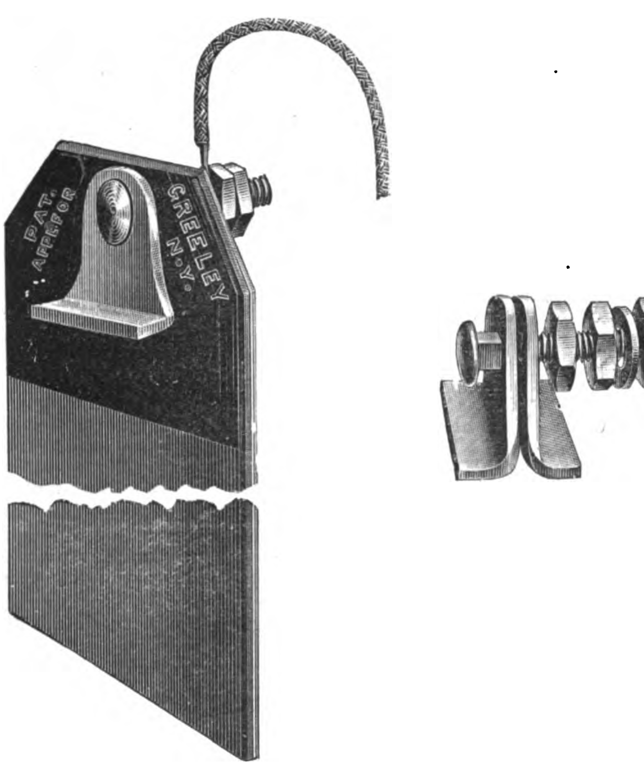
THE S. & C. INTERLOCKING CARBON CONNECTOR.

SINCE the introduction of carbon batteries for telephone service by the telephone companies, much trouble and annoyance has been caused by the use of a carbon connector which did not insure a tight and rigid connection with the carbon. There was no means of securely locking the wire in place and loose connections would often occur through the handling of the battery and not be noticed until considerable expense had been resorted to, to locate the difficulty.

The E. S. Greeley & Co., who were among the first to notice the fault with the old style, have produced a carbon connector called the S. & C. Interlocking, which they claim gives a perfectly rigid grip upon the carbon and connecting wire, and will not turn or work loose after once having been locked in position.

We present two views of the S. & C. connector herewith, one showing it in detail and the other as it appears on the telephone standard carbon.

The principal features of the S. & C. are its interlocking qualities, the large contact surface and the means of supporting the carbon on the battery cover.



FIGS. 1 AND 2.—THE S. & C. INTERLOCKING CARBON CONNECTOR.

It will be noticed in the detailed cut that the bolt has a square neck and that it fits into square holes in the contact plates, thus interlocking and preventing the bolt from turning when the nuts are screwed up.

A SIEMENS-HALSKE CENTRAL STATION FOR DE PERE, WIS.

THE DE PERE, WIS., ELECTRIC LIGHT AND POWER CO. has installed a nice little central station plant of the Siemens & Halske three-wire direct current system, run by water power. The generator is a 100 k. w. machine, with Siemens & Halske generator. The station is of brick and wood, with iron roof. There are six miles of circuit, all of rubber covered wire. The plant is driven by two 60 h. p. Victor turbines, regulated by an electric governor. The company is new, with a capital stock of $20,000. J. P. Donsman is the president, C. G. Wilcox, manager, and J. S. Chase, secretary. Attention will be paid to motor work, and it is already intended to run a small planing mill, a machine shop and three printing offices. De Pere is about five miles from Green Bay, where an electric railway system has been started, De Pere being the ultimate objective point.

NEW GENERAL ELECTRIC CAR MOTORS IN DENVER, COL.

SOME of the new type of car motors of the General Electric Co. have recently been in use by the Denver Tramway Co. Mr. C. K. Durbin, the superintendent, speaks highly of them.

One of the equipments is mounted on a 30-foot combination Brill car, equipped with Brill No. 11 maximum traction trucks, and is running on the Harman line from Eighth and Broadway to the town of Harman, a distance of two and one-third miles. The round trip is made without any trouble in 20 minutes, which is nearly 14 miles an hour, including stops. There are 16 curves on the round trip, so that the car makes 48 curves in an hour. The distance traveled by this car during the 18 hours' run is about 270 miles. This it does with apparent ease, and without any heating. The car has now been running regularly since noon of July 21, and has not missed a trip to date. Another car of the same kind is running on the Pearl Street line, directly two miles south from Alameda Avenue. The round trip of four miles is also made easily in 20 minutes. This car makes about 240 miles a day.

BRUSH AND SPERRY PLANTS.

FOURTEEN of the Brush 65-light 2,000 c. p. arc dynamos comprising the service plant in Machinery Hall, have been sold, 10 of them to the new Boston electric light station, and four to Mr. John E. Ridall, of Pittsburgh. The machines are to be shipped at the close of the Fair.

The Sperry Company have sold, through Mr. S. A. Douglas, an equipment of five of their new type motors to the West and South Towns Railway Company of Chicago. This line is to be in operation about Sept. 15, and will run east and west on Twenty-second street. It forms the nucleus of what will before long be a large system.

REPORTED ELECTRIC LIGHT CONSOLIDATION IN ST. LOUIS.

THE reported absorption of the Municipal Electric Light and Power Company and the Missouri Electric Light and Power Company, of St. Louis, by the Edison Illuminating Company, is confirmed. The stockholders and bondholders of Missouri and Municipal companies will exchange their property for cash and Edison securities. The Municipal company has a debt of $1,500,000 6 per cent. bonds and a capital stock of $1,500,000. The Missouri company has issued $500,000 first mortgage 6 per cent. bonds and $600,000 second mortgage 6 per cent. bonds.

PHILADELPHIA NOTES.

HARRY S. SMITH & CO., LTD., have been awarded the contract for the electric light wiring, signal service and burglar alarm system for the residence of the Hon. Alan Wood, Jr., of Woodmont, Pa. The work will be done under the supervision of Dr. W. A. Drysdale, consulting engineer. Brass-covered conduit, Cutter flush switches and special devices of unique design will be used; and when completed it will be one of the most complete installations in the city.

THE PENNSYLVANIA ELECTRIC ENGINEERING COMPANY will commence at once the construction of four miles of electric railway for the Marion (Ohio) Electric Railway, Light and Power Company. They are also installing a 400-light plant in the Musical Fund Hall, corner Locust and Ninth streets.

THE CUTTER ELECTRIC AND MANUFACTURING COMPANY find it necessary to run their factory full time in order to keep up with orders for their well-known specialties. Mr. Cutter says they are unusually busy in their construction department.

THE LA ROCHE ELECTRIC WORKS have opened a branch office at St. Louis, Mo. Mr. Owen Ford, recently with the General Electric Company, at Chicago, will be in charge.

MR. GEO. W. BACON, formerly with the Wightman Electric Manufacturing Company, of Scranton, has been engaged by the the La Roche Electric Works.

WESTERN NOTES.

THE PHŒNIX IRON WORKS CO., Meadville, Pa., and 519 The Rookery, Chicago, advise us of the following that have just put in Dick & Church engines: The Pittsburgh Construction Co., two 100 h. p. for lighting the Ferris wheel plant at the World's Fair; the Northern Light Electric Co., Wahpeton, North Dakota, 100 h. p.; the Marine City Electric Light Co., Marine City, Mich., 100 h. p. All the above are non-condensing compounds.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. SEPTEMBER 27, 1893. No. 282.

NOTES ON AN INDUCTOR ALTERNATOR.

BY

THE principle of inductor machines is not new, much work already having been done in that line by investigators who appreciate the value of the principle. As a result of this work, several types of inductor machines have been evolved, descriptions of which have, from time to time, appeared in current electrical journals. Among those who have spent much time and energy in working out the application of this principle is Prof. D. B. Brace, of the University of Nebraska.

The chief difficulty has been to obtain a machine with no thrust and a minimum air gap. This is quite overcome in Prof. Brace's type, a distinctive point of which is that the magnetic circuit is so balanced that there is no thrust. This arrangement admits of a minimum air gap, since no provision need be made for the wear of the thrust bearing. Another distinctive point is that the magnetic circuit is so arranged that the lines of force are swept around with the rotating inductor or keeper. Before describing this type in detail, it may be of interest to note, briefly, some of the laboratory models, built several years before the final type and which involve its fundamental principle.

In one form the inductor is a broad piece of iron, oscillating over the armature coils, which are slipped over the branches of the magnetic circuit. This oscillatory motion,

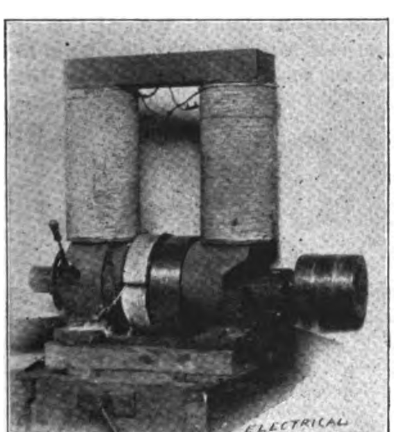


FIG. 1.

of course, excludes this form of machine from the commercial field; still, as a laboratory model for showing the principle involved it is satisfactory and its output is fully as high as was anticipated.

Fig 1 shows a form in which the inductor is rotated on a shaft, the armature coils being placed on but one side of the inductor. This position of the armature coils destroys all magnetic balance, thus necessitating the use of thrust bearings, which is, in this case, a weak point. The necessity of a thrust bearing has been obviated in another model by placing the armature coils on internally projecting branches of the magnetic circuit, before which the teeth of

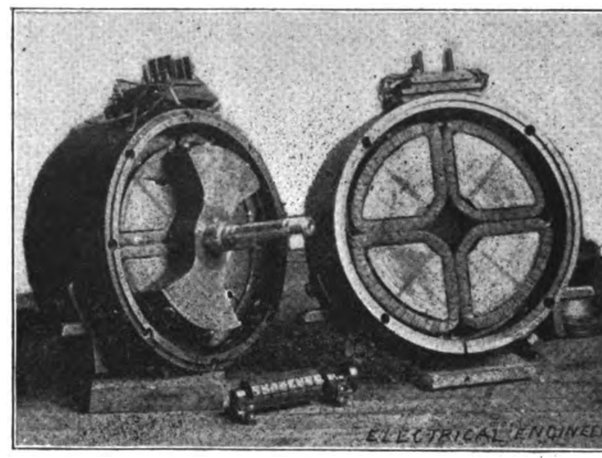


FIG. 2.

the inductor pass. The design of this machine is ideal in its simplicity, since the entire body is made of laminated iron, the laminæ of which may be stamped from single plates.

A description of the machine represented in Figs. 2 and 3 will serve to illustrate the type. This machine was built in 1889 for laboratory and lecture-room purposes, and has been in constant use since that time in the electrical laboratory of the University of Nebraska. The field magnets consist of two long bands of iron wound in the form of flat spirals, with asbestos between the convolutions to prevent eddy currents. These flat spirals are cast into the body of the machine and then faced up on a lathe. This construction requires very little lathe work and leaves but one joint in the magnetic circuit. Slots for receiving the armature coils are cut on conjugate diameters of these flat spirals, thus giving the field magnets four pairs of pole pieces. Over these pole pieces are slipped the armature coils, eight in number. Each field magnet is energized by an annular field coil which is placed in position before the armature coils are slipped over pole pieces. Between the field magnets revolves a laminated iron keeper, or inductor, two inches thick and of such shape as to cover two diametrically opposite armature coils. The function of this keeper is to sweep the lines of force through the successive armature coils. Its weight is 35 pounds, and it has been run at the speed of 4,000 revolutions per minute without causing any perceptible unsteadiness in the machine. This rotating inductor clears each field magnet by $\frac{1}{64}$ inch, leaving an air gap of only $\frac{1}{32}$ inch. Such small clearance necessitates the use of a thrust bearing, which, however, is of no disadvantage in this case, as from the form of the magnetic circuit, it will readily be seen that the same number of lines of force must pass out through one air gap as enter the keeper by the other, regardless of the relative size of the two air gaps. Thus it is impossible for the lines of force to

shorten themselves by pulling the keeper against either of the field magnets, and hence there can be no thrust. Experience bears out this assertion. The thrust bearing in the machine to-day, after more than four years' use in the laboratory, shows no appreciable wear. This is a point that should be emphasized, because the unsatisfactory results given by machines in which there are enormous thrusts have created a general prejudice against any machine having a thrust bearing, notwithstanding the fact

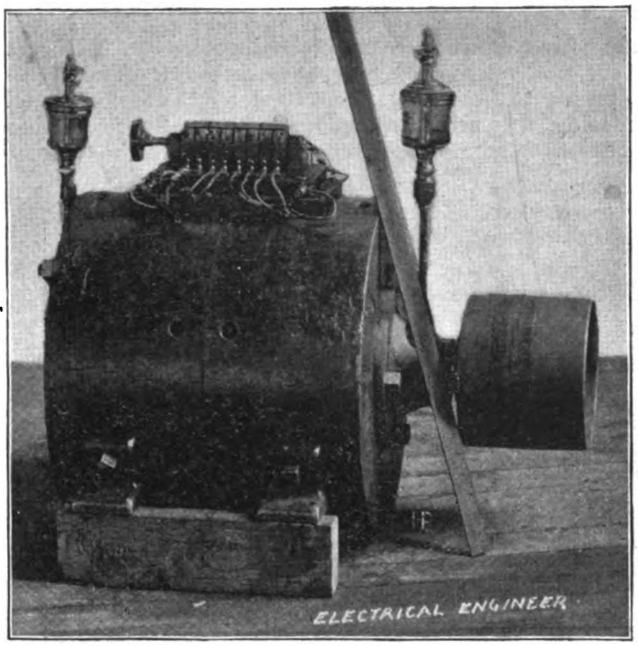


Fig. 8.

that there may be no true thrust whatever in the machine.

As there is no reversal of magnetism in this type of machines, the loss due to hysteresis is very small. So, also, is the magnetic leakage between each pair of pole pieces, when not covered by the inductor, for the magnetic circuit branches through the armature coils and when the inductor is before one set of pole pieces that branch of the magnetic circuit furnishes very little resistance to the lines of force as compared with the other branch. Moreover, the current passing through the armature coils of one branch due to the E. M. F. of the coils before which the inductor may be, tends to choke back what few lines may leak through that branch. Thus the leakage is very small, so small in fact, that, as shown by data obtained, it may be entirely neglected without introducing any appreciable error.

As this machine was built for laboratory use, the eight armature coils are fixed to a commutator, by which any desirable combination of the coils may be made, while the machine is running. This arrangement admits of a very large range of voltage and ampereage. The shaft, too, is fitted with a commutator by means of which a direct current may be obtained when desired. These commutators render the machine very convenient for laboratory apparatus.

The usefulness of this type is by no means confined to the laboratory, but extends over the commercial field as well, for the design is simple, the construction is cheap, and the efficiency under full and partial loads is high. This particular machine, which was constructed hurriedly of such materials as were at hand, running at 1,500 revolutions, under only one-fifth load gave an electrical efficiency of over 96 per cent., while the commercial efficiency exceeded 93 per cent. When run at its normal speed, 3,000 revolutions per minute, under full load, it gave an electrical efficiency of 97 per cent. with a correspondingly high commercia, efficiency. By careful construction and selected materiall one is justified in predicting an efficiency higher than that of the machine just described. Another point that recommends this type to the commercial field, is its compactness. The machine described, weighs only 650 pounds, gives an output of 17 kilowatts, and occupies less than four square feet of floor space.

WHAT HAPPENS IN THE WICKS QUAD.

BY

The unsatisfactory results of Mr. D. B. Grandy's experimental tests of the Wicks quadruplex arrangement (which was described by Mr. Maver in The Electrical Engineer, of the 16th ult.)—probably arise from the unsuitability of the apparatus employed.

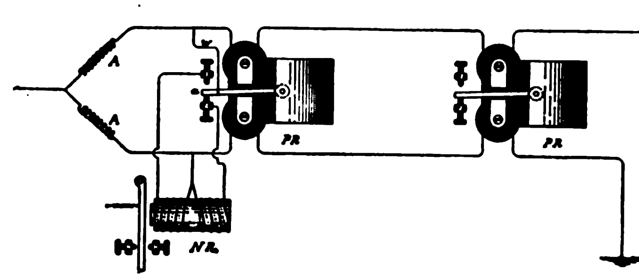
As a matter of fact, Mr. Wicks' device has been in successful operation over some of the Western Union's longest lines for several months past.

It is highly improbable that the three distinct periods named by Mr. Grandy as occurring during the process of reversal in the polarity of a magnet are all applicable to the bridge relay of the Wicks quadruplex system. In the first place the winding of the bridge coils is such that a reversal of the current by the distant pole-changer cannot affect the *polarity*, but only the *strength* of the magnetism developed in N R (see Figure).

Neither is it likely that the discharge of P R and N R can be effected *simultaneously* for the reason that the inductance path through N R is greater than it is through P R.

The interval of "no current" during the reversal of the distant pole-changer is apparently so small as to be more or less effectually bridged by the self-induction in the circuit and magnetic lag in the cores of N R, which prevent the magnetization of that apparatus from falling to a value sufficiently low, or of such duration, as to affect the signals on the No. 2 side.

The succeeding or "recharging" current of opposite polarity on the other hand, rises rapidly in P R, whose armature responds before that portion of the current which has meanwhile passed into N R, has had *time to reverse* the magnetism there, or in fact to materially disturb its pre-



Wicks' Quadruplex Arrangement.

existing value. That this is so may be readily proved by inserting a galvanometer in circuit with the particular coil of the neutral relay which happens to be connected with the main line. A current sent in the proper direction can now be made to reverse the armature of P R, but before doing so, a portion of said current should pass through the galvanometer into the coil above referred to. It is found, however, that either this amount is so small, or the action of P R is so rapid, that no deflection of the galvanometer is apparent, until the controlling armature of P R is

strongly biased so as to retard its motion from one contact point to the other. It would thus appear that the *time* required to reduce the magnetism in N R to a point below that of the retractile force of its spring is greater than the double interval introduced by the combined armature movements of the pole-changer and polar relay, the latter of which can be adjusted very closely. But perhaps the most important advantage of the Wicks device consists in the fact that it renders possible the substitution of a permanent magnet in place of the ordinary soft iron yoke of the neutral relay, thus converting the latter into a polarized instrument of great sensibility to weak currents. This arrangement has been adopted in practice, and the results have demonstrated that not only is the "period of no magnetism" entirely obviated as claimed by Mr. Maver, but that by means of this system quadruplex working can be successfully maintained under conditions that have generally resulted heretofore in reducing the capacity of the wire to that of duplex-working when other systems were in use.

WORLD'S FAIR DEPARTMENT.

THE WLADIMIROFF STORAGE BATTERY.

THE electrical exhibits at the World's Fair are by no means confined to Electricity Building, and, indeed, it has been truly remarked that Machinery Hall offers quite as good, if not a better, idea of what electricity is capable of accomplishing. In nearly all the foreign sections, for example, we find electrical devices of varied character, and in the Russian section we note a type of storage battery worthy of more than passing notice.

This battery is the design of Mr. N. Wladimiroff, ex-lieutenant of the Russian Imperial Guard, and its construction involves several points of interest. The battery, being intended specially for portable work, such as boats, train and carriage lighting, etc., lightness was a first consideration, but at the same time attention has also been given to the other details, such as freedom from spilling of acid, indestructibility of the containing vessel, etc.

We may premise that the battery is of the series type in which one side of each plate constitutes a positive and the other a negative element, the plate itself acting as the necessary partition. A series of the plates are ranged side by side to form the cell. Our engraving, Fig. 1, shows a group of four cells exhibited in Machinery Hall. The lead plates, whose diameter varies, of course, with the capacity of the cells, consists of a central sheet, A, Figs. 2 and 3, cast with a thin spiral web, B, B, on each side. The trough or groove between the spiral webbing is filled with the active material, C. After the plates have been thus filled they are assembled by clamping them between a series of hard rubber rings which bear against the outer circumference of the plates A. These rings, as shown in Fig. 4, have a thin rib running for a short distance along their lower end to catch any active material that may drop from the cells and prevent it from short-circuting the plates; rubber washers between the rings also aid to keep the cells acid tight, the rings being grooved for that purpose.

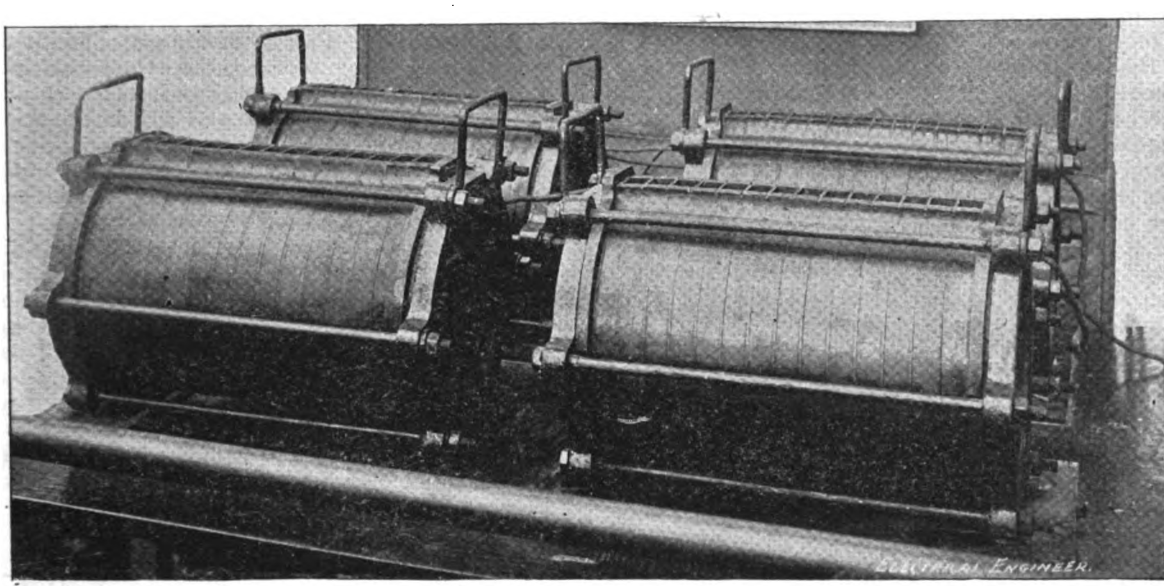


FIG. 1.—WLADIMIROFF STORAGE BATTERY.

The insulating rings and the plates alternate and the space between them is filled with acid, which is poured in through a small opening at the top of each ring as shown in Fig. 1. In the battery exhibited, 14 plates are so mounted to form one battery, and the whole is held together by iron bolts.

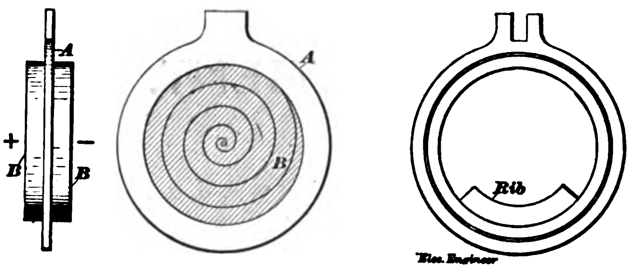
Since each plate is positive on one side and negative on the other, it follows that the E. M. F. of each cell is added to that of the others, so that in this case each battery has an E. M. F. of over 28 volts. Each of these batteries weighs about 180 lbs.

The judges in the Department of Electricity have examined the battery, but their report is not yet public property; in the meantime, however, it may be interesting to cite the results obtained by the officers of the Russian Torpedo School last February, and submitted by them to

the Chief Torpedo Inspector of the Russian Navy, as follows :

Maximum Charging Current	10 amperes.
Normal " "	8 "
Capacity at above current	30 to 33 ampere hours.
Weight per watt	0.3 pound.
Cost per watt	(12 copeks) 6 cents.
Efficiency	75 to 80 per cent.
International resistance, 14 elements in series	0.186 to 0.19 ohm.
Acid per element	750 to 850 cub cms.

The report also states that the handling of the Wladimiroff batteries is far easier than that of the type hereto-



FIGS. 2, 3 AND 4.

fore in use at the torpedo school. The mounting and taking apart of the cells can be readily accomplished and no leakage takes place.

As to the hardiness of the plates, a test was made, first, with a current of 80 amperes for 10 minutes and then with 176 amperes for four minutes. After the discharge had been stopped the battery quickly reached its previous E. M. F. and capacity. On both these occasions the battery was taken apart and examined, but showed no ill effects.

Similar exacting tests were made by the Testing Committee of the recent Moscow Electrical Exhibition, as a result of which a gold medal was awarded to the inventor.

The battery, we are informed, has been adopted in many installations in Russia, among others for lighting the imperial carriages at St. Petersburg. The battery which has been recently patented in the United States is in charge of Mr. Peter Renko, of Chicago.

CLOUD PROJECTION AT THE WORLD'S FAIR.

WHAT promises to be not only of considerable scientific interest, but also of great commercial value, is a method of projecting words and designs upon the clouds by means of electric projectors, which will be put in operation at the World's Fair within a few days.

The system is the invention of Mr. L. H. Rogers, of the Brush Electric Company, and is the result of many months of experiment begun on the search light installed so successfully by Mr. Rogers on Mount Washington in the White Mountains, last year, and of which we published a full and illustrated description at the time.

Arrangements have been made by which one of the 44-inch Schuckert projectors from the Manufactures and Liberal Arts Building will be employed for the present. The apparatus is now quite ready for operation and is only waiting for the cutting of a hole in the roof of the Electricity Building. The exact night for starting up cannot therefore be definitely announced, but it is certain that within a day or two the projector will be in operation at the Fair.

A number of plans are on foot for providing a suitable screen when amiable clouds are not at hand. Mr. Pain, the pyrotechnic engineer, is preparing special bombs to be thrown into the air to produce large white clouds upon which pictures and signs will be shown. Arrangements for a number of jets of steam to issue from the roof of Machinery Hall are also making. This will afford a suitable screen upon which the signs and pictures can be thrown.

The character of the pictures and signs will be under the direction of the Fair officials. They have authorized the announcement of the programme and special features for the day following and the number of visitors to the Fair each day, the pictures to include a likeness of Columbus, President Cleveland, and all of the prominent Fair officials.

President Higginbotham of the World's Fair who was recently afforded a private view of the apparatus in operation has expressed himself in terms of the highest praise as to the practicability and commercial value of the scheme.

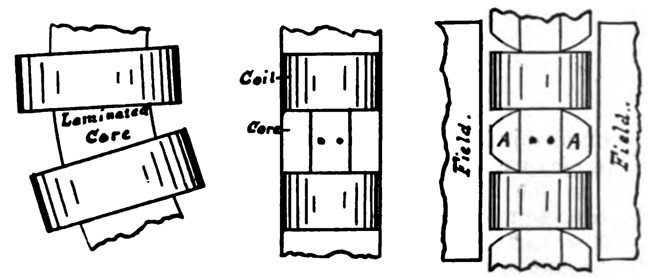
The company operating the system is the Cloud Projector Company of which Mr. L. H. Rogers is president, Mr. Elmer E. Sperry electrician, and Mr. F. I. Rogers general manager. Within a very short while the company expect to have 25 to 30 projectors in operation in various parts of the country, throwing advertising signs against the clouds. In comparison with this advertising the circus bill poster will dwindle into insignificance. We believe that there is here opened up a ligitimate and highly profitable field which electric light companies all over the country would do well to look into seriously. The company already has a number of large contracts on hand. The system, we may add, is fully covered by patents on the various devices which have been found to be necessary to insure success.

THE NEW BRUSH 125-ARC LIGHT MACHINE.

ALTHOUGH the Fair is nearing its close, new apparatus is constantly being added to the exhibits already in place, and among the notable additions in this respect is the new 125-light arc machine of the Brush Electric Company, direct coupled to a Willans' compound engine, both mounted on the same bed plate. The combination is shown in the accompanying engraving, Fig. 1, and has attracted a great deal of attention.

In general appearance the machine does not differ materially from the usual type of Brush arc machine, but on close examination, it shows some departures from the method of construction heretofore adopted. The machine has four poles and the armature is cross connected so that only one set of brushes is used with the usual three rings, each ring having eight segments. The magnet cores are of soft steel.

The armature has been subjected to a special study in this machine, owing to the high voltage employed and for the particular purpose of reducing the sparking at the commutator. In the old type of machine, it will be remem-



FIGS. 2, 3 AND 4.

bered, the shape of the sheet iron pieces, which go to make up the core was such as to make a uniform cylindrical surface, as shown in the engravings, Figs. 2 and 3, which illustrate, respectively, a side and an end view of a portion of the old style armature. In order to make the line of commutation as sharp as possible, the armature core plates of the new machine have been tapered off on both sides between each pair of the coils, presenting the appearance shown at A, in Fig. 4. With this construction, the result has shown that the sparking is greatly reduced. The armature is wound with 24 bobbins having 528 turns each, of No. 14 wire. Each of the field cores is wound with 1,560 turns of No. 8 wire. The whole machine weighs 9,000

pounds, has a 38 x 44 inch base and is 4 feet high. These dimensions are smaller than those of the No. 8 Brush 65-lighter, which was 87½ inches long. The total length of the new machine from pulley to commutator is 84 inches. The combination as it stands, engine and dynamo together, occupies a floor space 4 x 11 feet.

engine works of The Bullock Manufacturing Company, the ampereage of the machine was varied between 4.29 and 12.1 amperes. The curve representing the amperes rises gradually up to a point represented by 9.4 amperes and then falls abruptly. The curve is almost an ideal one, and represents the great desideratum in an arc lighting machine,

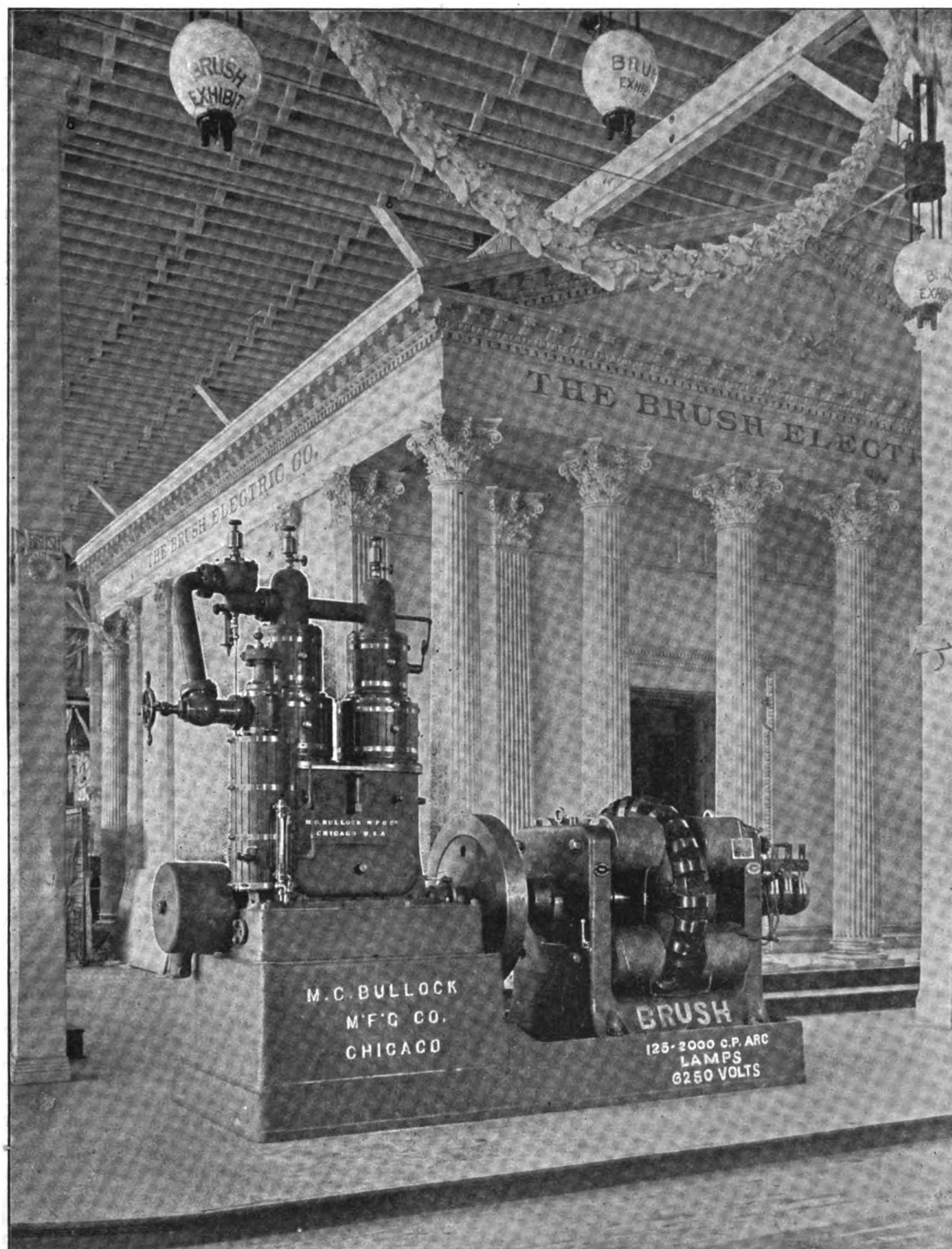


FIG. 1.—BRUSH 125-LIGHT GENERATOR.

The machine is designed to give 6,250 volts at 525 revolutions, but the engine to which it is coupled, being designed for only 460 revolutions per minute, allows the dynamo to generate only 5,200 volts, equivalent to 100 lights.

The external characteristic of this machine is highly remarkable, showing the perfection to which this type of apparatus has been brought. In a recent test made at the

and one, especially, in which the voltage is as high as it is in this case.

The engine to which the dynamo is connected is of the well-known Willans type, which has met with such enormous success in electric lighting in England, and the manufacture of which, under sole license for the United States, has been undertaken by the M. C. Bullock Manufactucing Company, of Chicago. Many tests have been made, show-

ing the great economy in water consumption of these engines, the recent test of Prof. Kennedy, showing 13 pounds of water per horse-power hour. A number of these engines are also shown in operation in Machinery Hall, driving dynamos and a part of the line shafting for the distribution of power.

RAILROAD DAY AT THE WORLD'S FAIR.

Saturday, Sept. 16, was Railroad Day at the World's Fair and as such served to draw together a large and representative gathering of railway men from all over the country.

The chief feature of the day was left for the last and consisted of a tug-of-war between the General Electric Company's electric locomotive and a passenger steam locomotive of the Baltimore and Ohio Railroad. The two locomotives were placed on the north track at the Terminal Station, so that it was necessary to run cables to the electric locomotive, which it was, of course, obliged to drag to and fro, being off its regular track equipped with trolley wires.

In order to fully understand the results it must be explained that the steam locomotive weighed 32 tons on the drivers, while the electric locomotive has a weight of only 27 tons resting on the drivers. The electric locomotive, which was fully described in The Electrical Engineer of recent date, has two 300 h. p. four-pole motors.

The two locomotives were joined by a ⅞-inch stranded steel cable made by the Washburn and Moen Manufacturing Company, and the usual handkerchief tied to the centre served as the mark over the "scratch," which in the present case consisted of a board laid across the track. It was arranged that at the signal each should pull.

On the first test the signal was not seen by the motorman of the electric locomotive, with the result that the steam locomotive started first and got up sufficient momentum to pull its competitor over the scratch, notwithstanding that the wheels were skidding.

The judges decided to rule this test out and on the second trial both started together. The result was the same, however, the electric locomotive, as in the first test, skidding its wheels, but to no avail.

It was then decided to allow the electric locomotive to start first and thus to have the advantage of acquired momentum. But this test also turned out in favor of the steam locomotive.

Finally the connecting cable between the two locomotives was discarded, the two coupled directly together and allowed to push against each other instead of pulling. Here also the steam locomotive turned out the victor and in consequence was awarded the blue pennant.

The result might have been predicted when one considers the disparity in weight between the two locomotives—five tons, in favor of the steam locomotive. That the electric locomotive was equal to more than its present performance was shown by the fact of its wheels skidding in opposite directions to its motion while being pulled by the steam locomotive. With equal weight on drivers the result would probably have been different.

Chief Smith of the Transportation Department acted as judge for the steam locomotive, and Chief Barrett, of the Electrical Department for the electric locomotive, while General Manager Merrill of the Chicago, Burlington and Quincy Railroad, was referee.

After the tug-of-war, which was viewed by thousands, the party partook of refreshments in the Transportation Building and then separated.

During some speeches in the morning exercises, Lieut. E. J. Spencer, of the General Electric Company stated that the Intramural Railway, equipped by his company, represented the longest and the heaviest train ever hauled in elevated railway passenger service; this was the excursion train, consisting of one motor car and seven trailers occupied by the party. He also stated that owing to lateness it was impossible to put in ordinary overhead construction, but that cables would have to be used in the proposed tug of war test. Lieut. Spencer also remarked that whether the electric locomotive won or lost, it would be found that the wheels would be revolving in the direction against the pull, showing that the power was there,—which turned out to be the case. He added that the engineering problem had been solved here, and that it was not merely a question of dollars and cents. Each project would have to be taken up on its merits, but that for suburban and intraurban work the electric locomotive was here to stay.

That the test was not a fair one is acknowledged even by the Baltimore & Ohio Railway officials. For, in addition to the increased weight of the steam locomotive, the latter had probably not been in the shops for six months, and in consequence its wheels were worn down so that they almost completely conformed to, and made contact with, the entire top of the rail. As the electric locomotive had never seen actual service, its wheels were as perfect as when they left the shop, and the rails showed but a thin line of contact where it had passed over them. Naturally the increased adhesion due to the worn wheels gave the steam locomotive a grip on the rails even beyond what its increased weight would call for. There are also rumors about that the safety valve of the steam locomotive had been "fixed" for the test, and that instead of popping at 125 lbs. pressure it had been set for 140 lbs. per square inch boiler pressure.

In view of these facts another trial is now being arranged for, in which the conditions will be made as uniform as possible on both sides.

JUDGING THE EXHIBITS.

The judging of the exhibits is progressing rapidly and although the facilities placed at the disposal of the judges by the exhibition authorities have been exceedingly meagre, they have been more than counterbalanced by the intelligence and zeal of the judges. We have already given the methods employed by the committee who have in charge the testing of the incandescent lamps, and are now able to present the schemes and methods of some of the other committees.

AUTOMATIC CONSTANT CURRENT DYNAMOS AND MOTORS.

The arc dynamos and motors will be judged as follows:

1. Examination of machines for mechanical and electrical workmanship, and tests for regulation under various loads.
2. General effectiveness in performing duty as shown by machine operating on circuits.
3. Comparison of claims made by exhibitors with known performance of similar machines in general practice.

In case known performance of machines in general practice does not coincide with exhibitor's claims, tests of machines may be made. These to be:

4. *a*, Efficiency tests of dynamos at full speed and half loads. *b*, Tests to determine power at the belt required to operate each normal arc lamp at full and half loads. Normal arcs to be defined as consuming about 450 watts per nominal 2,000 c. p. lamp, and about 300 watts per nominal 1,200 c. p. lamp.

Points 1 to 3 shall have equal weight in determining awards. If tests under point 4 become necessary, test "*a*" shall have only one-half weight.

It will be observed that no systematic tests will be undertaken on these machines except under the conditions above mentioned.

Constant pressure dynamos and motors (*except two and three phase alternating machinery, combination sets, and special applications.*)—This class of apparatus will be judged for the following points:

1. Examination of machines for mechanical and electrical workmanship, and tests for regulation under varying loads.
2. General effectiveness in performing duty as shown by machines operating on circuits.
3. Comparison of claims made by exhibitors with known performance of similar machines in general practice.

In case known performance of machines in general practice

does not coincide with exhibitor's claims, tests of machines may be made. These to be:

4. Efficiency tests of machines at full and half loads.

Points 1 to 3 shall have equal weight in determining awards. If tests under point 4 becomes necessary, the point shall also receive equal weight in determining awards.

ELECTRIC RAILWAY MOTORS AND EQUIPMENTS.

On account of the wide range in the exhibits in electric railway machinery, they will be arranged in two classes for the convenience of the judges in making their examinations. Their classification and the records described below are for the purpose of assisting the judges in forming an estimate of the value of the exhibits. The classification will be:

a. Exhibits prepared for operation.

b. Exhibits not prepared for actual operation.

The judges deem it desirable that full information be obtained in each of the classes, and in class *a* that the operating records be particularly complete. The records to be preferably from machinery operating on the grounds of the Exposition, but when these are not complete, full records of machinery operating on roads at other places may be accepted in the place of, or to complete, the Exposition records. Records from other points are also desirable for comparison in making the reports.

a. Exhibits prepared for operation.

When the machinery entered for awards is in the form of complete equipments ready to operate, it is particularly desirable that the examination for awards be preceded by a careful examination of the actual performance of the machinery when in operation on tracks within the Exposition grounds. The specific points to receive special attention are:

1. Prompt starting of load without excessive expenditure of current.
2. Ready acceleration of load.
3. Controllability.
4. Draught bar pull.

The available tracks will not admit of tests being made to determine the power required to handle various loads at different speeds, and the experience of common practice must therefore be here relied upon.

Where the machinery is operated in regular service on the Exposition grounds (the Intramural Railway) additional information to be used in the findings will be taken directly from the daily operating records covering a considerable period, with the exhibitor's permission, as follows: Consumption of fuel in pounds and the expense thereof (accompanied with a description of the kind and quality of the fuel); consumption of water for feeding boilers, if record is available; ampere and volt records taken from switchboard instruments; total cost of operating power station, less cost of fuel; train miles run; ton miles run; passengers carried; cost of operating power station per ton mile; total cost of operating trains per ton mile; total number of delays to trains due to derangement of machinery; total time lost by trains due to same cause.

These records should cover a period not less than one month. In the case of the Intramural Railway it is suggested that the record for the thirty-one days of the month of August be relied upon. The records so obtained to be analyzed and compared with such similar records as are obtainable, from the operation of the elevated railways of New York, Brooklyn and Chicago, and the results to be incorporated in the judges' report.

It is desirable to obtain a continuous daily speed record of one of the trains of the Intramural Railway, and a recorder will be placed on one of the trains with the approval of the exhibitor, if the same can be procured.

It is desirable for exhibitors to furnish the judges with drawings which show in sufficient detail the types and dimensions of motors, controlling devices, etc., and the arrangement of their machinery in the cars, also maps and details of the railway. How far these shall be incorporated in the reports will be determined after consultation with exhibitors, and a consideration of the novelty and economy of the device.

Awards will be based upon "specific points of excellence or advancement" included in the mechanical and electrical design, construction, and operation of the apparatus; effectiveness in performing duty for which the apparatus is designed; and advances within the limits of electric railway practice.

b. Exhibits not prepared for actual operation.

In judging exhibits not prepared for operation on the tracks of the Exposition grounds, the following points will be examined:

1. Mechanical and electrical design, construction and finish.
2. Comparison of claims made by exhibitor with known performance of similar machines in general practice.
3. In case known performance of machines in general practice does not coincide with exhibitor's claims, tests of similar machines operating on the street railways in or about Chicago may be made, provided the time at the disposal of the judges will warrant it, and the opportunity is afforded.

The reports will show in condensed form such complete information regarding the machinery and apparatus, the best condition for its operation, and the results obtained in general practice as seems desirable after consultation with the exhibitor.

MOTOR DYNAMOS.

The motor dynamos will be tested merely by putting an ammeter and voltmeter on each side of the circuit, and obtaining the efficiency from the indications thus obtained.

SALAMANDER WIRE AT THE WORLD'S FAIR.

On Monday, Sept. 18th, public tests of an extraordinary character were made in Electricity Building. The Washburn & Moen Manufacturing Company, it will be remembered, have at their exhibit a full complement of all wires used in electrical equipment, insulated wires from the size of a human hair up to the two million circular mils cable are shown in their display. Very prominent display is also made by them of their Salamander house wire and incandescent cords.

On the day mentioned the most conclusive test yet shown was a lead encased wire and an Underwriters' wire in series with an equal length of the Salamander wire. A current of 160 amperes was then applied to the terminals. The lead covering $\frac{1}{16}$ inch thick was melted off, the insulation ignited and the wire fused, while the Underwriters' wire was bared of all covering. On cutting into the Salamander the rubber could yet be stretched. The last and probably the most satisfactory test was made by taking a two-foot piece of Salamander wire and connecting both ends to the testing machine and applying a current sufficient to fuse the copper conductor and form an arc in the inside of the insulation; this was done without even a particle of smoke arising from the exterior of the insulation. Tests of a similar nature are made nearly every day.

TESTING THE DIRECT CONNECTED DYNAMOS.

The tests of the large direct connected dynamos were begun on Wednesday, Sept. 20, the first of the engines and dynamos taken in hand being the 10,000 light quarter-phase Westinghouse alternator, driven directly by a Westinghouse compound engine. The combination designated as No. 2 of the Westinghouse plant, in Machinery Hall, was operated on regular work up to midnight, and from that time forward, until the gray of dawn appeared, the judges and their assistants were kept busy.

As the dynamo consists practically of two independent machines double sets of electrical readings had to be taken. Some difficulty was experienced, which will probably have to be allowed for owing to the fact that the boiler pressure available was only 125 pounds, while the engine was designed for 150 pounds pressure. Other difficulties were also met with owing to the lack of co-operation of the exposition authorities, and it is safe to say that but for the interest which the judges have taken in their work and the substantial help of the companies themselves, these tests, as well as others, could not be carried out.

The tests to follow are those of the 500 h. p. Allis engine, directly connected to a Westinghouse railway generator; and the Lake Erie engine direct connected to the railway generator in the Intramural Railway power station.

Dr. Emery, Prof. Ryan and Prof. Carhart have charge of these tests.

We have had numerous inquiries for copies of the admirable portrait group of the official delegates to the Electrical Congress appearing in our issue of Sept. 13. The photograph of the group can be obtained from Mr. Arnold, official photographer, Jackson Park, Chicago, for $1 and 10 cents postage. The name should be given in the order for the picture, as "Official Delegates to the Electrical Congress, taken on steps of Victoria House." The photograph is a large and fine one.

ELECTRIC RAILWAY DEPARTMENT.

REPORT OF COMMITTEE ON "THE RETURN CIRCUIT OF ELECTRIC RAILWAYS."[1]

BY THOS. J. McTIGHE.

On a wet day in moderate weather, the earth is available, and to a very large extent, I believe, considering that with a seventy pound girder rail and double track we have something like 30,000 square feet of earth contact per mile of track. But we cannot rely upon this doing us the same service in long spells of dry weather. Still more, we cannot rely upon it doing any good whatever in severe winter weather. It is not uncommon in this State for frost to penetrate three feet in the ground and to stay there for a whole winter. Under such circumstances, the earth return must go out of our calculation. It is during severe winter weather that we want to realize our very last watt in the hard pulls we must contend with almost daily.

We are told in mechanics that the strength of a structure is measured by that of its weakest part under the most unfavorable conditions it is to meet. Similarly, in a compound electric circuit, the total resistance must depend upon the condition of highest resistance to be met with in any of its component parts. We must plan so as to have our return circuit efficient in the most prolonged summer drought, and in the most severe frosts of winter. Ground plates and pipes laid below permanent water level are a refuge in a few favored localities, but the same can hardly be said of plates and pipes laid in the ground whose moisture depends upon the wayward elements.

I have made a large number of calculations as to what should be the total resistance per mile of the return circuit under different methods of the construction of the circuit. In making these calculations I have eliminated the conductivity of the earth, because in average winter weather the earth turns a very cold shoulder to the track. I have eliminated the conductivity of the fish plates, because I believe that under average conditions the comparatively small areas of contact surface are too much oxidized to be of much benefit. The most approved form of fish plate bears only at its upper and lower edges against the rail. The rail and plates are merely special forms of structural steel, rolled while hot, heavily oxidized at best, and usually rusted still more before being applied. Two such rolled surfaces never come into good contact and it cannot be expected. A straight edge laid along the bearing surface of the ordinary fish plate will convince any one who takes the trouble. Even on our magnificently constructed and continuously maintained steam trunk lines I have, on examination with my knife blade, rarely found a fit so perfect that I could not enter the blade at one or more points.

I have eliminated all the refinements upon which exact scientific analysis of the subject would insist, such as changes of temperature, moisture and other conditions which are more or less insignificant in the practical work. I have based the figures on the ratio of 6 to 1 in comparing the resistance of the ordinary soft steel rails with that of our usual commercial copper, and for the latter I have followed the ordinary tables adopted by the wire manufacturers.

I have not discriminated between the different assignable values for resistance in the various forms of rail bonds, and have calculated only for the specific metal used in the comparisons, leaving the merits and demerits of the form out of the question. I will refer to the last later on.

In studying the general situation prior to constructing, in the spring of 1891, the railway system of Lincoln, Neb. (of which my firm were supervising engineers), I investigated the subject somewhat closely. Though at the time and under the local conditions, an advocate of iron rail bonds, I was and am yet convinced that supplementary ground wires are an unwise extravagance. I will try to give you the reasons for this belief. In steel rails we usually say that every ten pounds weight per yard means one square inch of cross-sectional area. And every square inch of such area can be brought to terms of copper by dividing by six. The resistance is easily determined, and we thus readily arrive at some important results for comparison. For example, take the average city railway rail as being a 70 pound girder. Its area is substantially seven square inches, and the four rails of a double track make 28 square inches, equal to a single steel bar four inches thick by seven inches wide. This is electrically equal to a bar of copper having 4.66 square inches area, or, in other words, a copper conductor one inch thick and almost five inches wide. With such a magnificent path for our returning current, does it not seem absurd to supplement it with a No. 0 wire, whose area is that of a rod a little over a quarter of an inch square? But when we find the above rail resistance per mile to be but .0086 ohm, while that of the No. 0 wire is just 60 times greater, the absurdity seems to grow, and it becomes a case of sending a very small boy to do a very big man's work, with the man standing idle on the spot.

Calculating in like manner for some usual weights of rails, I obtain the following:

TABLE I.—DOUBLE TRACK.

Size of Rails.	Total Sectional Area.	Equivalent in Copper.			Resistance per Mile.
		Area.	Thick.	Wide.	
50 lb.	20 sq. in.	3.33 sq. in.	1 in.	3.33 in.	0.0121 Ohm.
60 "	24 "	4.00 "	1 "	4.00 "	0 0101 "
70 "	28 "	4.66 "	1 "	4.66 "	0.0086 "
80 "	32 "	5.33 "	1 "	5 33 "	0.0075 "
90 "	36 "	6.00 "	1 "	6.00 "	0.0067 "

As it would be tedious to carry all these into further comparisons, I will carry the analysis out mainly on the 70 pound rail, with one reference to the big 90 pound rail now being extensively used in large cities.

TABLE II.—70 LB. RAIL, DOUBLE TRACK.

Case.	DESCRIPTION.
1	No. 4 copper bonds, connectors and two No. 0 cop. supplementaries.
2	No. 4 copper connectors to rail ends, two No. 0 cop. supplementaries.
3	36 inch No. 0 iron bonds, single. No supplementary.
4	36 " " 0 " " double. " "
5	36 " " 0 copper bonds, single. No supplementary.
6	12 " " 0 " " " " "
7	36 " " 00 " " " " "
8	12 " " 00 " " " " "
9	36 " " 000 " " " " "
10	12 " " 000 " " " " "
	90 LB RAIL, DOUBLE TRACK.
11	No. 4 copper connectors to rail ends, four No. 0 supplementaries.
12	12 inch. No. 0000 copper bonds, double. No supplementary.

Cases 1, 2 and 11 are given as representing the system on which probably a large majority of electric railways have been constructed. A few roads have the supplementary doubled along both tracks, and a few have used slightly larger connecting wires than No. 4 B. & S. But I am trying to give the *average* of what has been accepted as first-class work, and will try to show it can be vastly improved. The West End and the Brooklyn City Railroad companies laid their tracks with double supplementary copper wires (No. 0 B. & S.), but found them totally inadequate, and now have put up many miles of huge return feeders or mains at great cost. Even these are inadequate. In Brooklyn these return mains (500,000 circular mils) are, when possible, suspended on the elevated railroad structure. I am informed that occasionally the insulation scrapes off and the return main makes contact with the iron work. Heat enough is developed at this leak to soften the insulation for many feet, thus showing that the resistance of the main return is still too high.

Taking the various cases set forth in Table II., I have constructed another table, and for the sake of fair comparison I have made the calculations on the same basis of elimination as previously noted. I am not aware that the subject has heretofore been followed up to the extent, and I think it will be found interesting and perhaps important.

Of course, in localities favored all the year round with wet ground, the above table would be seriously astray; but, as I have said, the table is based upon the most unfavorable condition, namely, earth frozen hard for two or three feet deep, and earth conductivity practically nil.

I must not take up your time with any extensive analysis of Table III., but I cannot forbear pointing out a few striking features. Take cases Nos. 2 and 6. The former is, no doubt, used by many members of this Association. No. 6 is the system of track circuit of the Atlantic Avenue Railroad, in Brooklyn, N. Y. No. 2 has a total track resistance of .0586 ohm, and costs, for material,

1. Abstract of Paper read before the New York State Street Railway Association, Rochester, N. Y., Sept. 19, 1893.

about $700 per mile, while No. 6 has a total track resistance of but .0180 ohm, and costs, for material, only $144 per mile. In other words, No. 6, in point of efficiency, is four and a half times a better electric circuit than No. 2, while costing just about one-fifth as much. In roads likely to have extreme heavy traffic, case No. 11 has been adopted, there being four No. 0 supplementary copper wires and the ordinary copper rail bonds or connectors; being thus merely an enlargement of No. 2, and used in connection with 90 pound rails. In case No. 12, the 90 pound rails are also used, but there are no supplementary wires, and each joint of the rails is supplied with *two* rail bonds of No. 0000 copper wire, each only 12 inches long. Comparing results, it is evident that case No. 12 is, electrically, about four times a better circuit than No. 11, while costing only about one-third as much.

TABLE III.—CHARACTERISTICS PER MILE, DOUBLE TRACK.

Case Number.	Total R of Rails.	Total R. of Rail Bonds	Total R of Track Circuit.	Fall of Potential for 200 Amp.	Total Energy Expended thus in Track Circuit.	Cost of such per Year at $100 per Kilowatt.	Approx. Cost of Track Circuit Material.
	Ohms.	Ohms.	Ohms.	Volts.	Watts.	Dols.	Dols.
1	.0086	0335	.0362	7.24	1.448	144.80	700.00
2	.0086	.0671	.0586	11.72	2.344	234.40	700.00
3	.0086	.0796	.0882	17.64	3,528	352.80	90.00
4	.0086	.0398	.0484	9.68	1,936	193.60	180.00
5	.0086	.0133	.0218	4.36	872	87.20	180.00
6	.0086	.0044	.0130	2.60	520	52.00	115.00
7	.0086	.0105	.0191	3 82	764	76.40	200.00
8	.0086	.0035	.0121	2.42	484	48.40	180.00
9	.0086	.0083	.0169	3.38	676	67.60	220.00
10	.0086	.0027	.0113	2.26	452	45.20	150.00
11	.0067	.0235	.0306	6.12	1,224	122.40	1,250.00
12	.0067	.0011	.0078	1.56	312	31.20	432.00

Now let us compare case No 12, as it stands, with case No. 11, but adding to the latter two 500,000 circular mils overhead returns connected heavily to the track circuit at frequent intervals. In case No. 11 the total track circuit resistance is .0306 ohm; that of the two 500,000 circular mils feeders about .0545 ohm; and the combination circuit measures about .0196 ohm. The cost of the two feeders (insulated) per mile of double track road would be approximately $2,800, to which we add the $1,250, cost of track circuit in case 11, making $4,050.

In short, though our case No. 12 gives us almost three times as efficient an electric circuit as the new case No. 11, the latter costs almost ten times more than No. 12. And yet the West End and Brooklyn City Railroad companies pin their faith in a circuit like case No. 11.

A glance at the sixth and seventh columns of Table III., is rather instructive. If we take a medium city system operating 20 miles of double track, the company which uses case No. 2 will pay several thousand dollars per year for the energy wasted in the return circuit, while the company using No. 6, or No. 8, or No. 10, will pay but a trifle in comparison, and save nickels by the quart. I am of the opinion that it would, to-day, well repay any company using copper supplementary wire to rebond its tracks on a basis of perennial low resistance, because on the average it would save the cost of such change in one year. And I say the same to those using iron rail bonds.

There is still another phase to this whole question of the return circuit to which I will briefly refer. I mean the *electrolytic decomposition of the rails*, when earth is relied upon as the major part of the return circuit. That there is such decomposition must be true. The soil under our paving has for many years been plentifully soaked with ammonia from animal refuse, with ordinary salt in the winters of bygone horse car days, and to these have been added the leakage from the underground gas pipes. Certainly such soil, when wet and in contact with the rails, presents all the requisite features of an active depositing bath, there being no dearth of cathodes below. Hence, so long as a considerable flow of current takes place from rails to earth, there must necessarily be a good deal of direct electrolytic decomposition of the rails. Let me take an extreme case. It would scarcely be exaggeration to assume that on Tremont Street, Boston, or Fulton Street, Brooklyn, there is a massing of slowly moving cars, amounting to, say, 100 for one mile of double track. Let the rails used be 70 pound girder, and for the current I should say twenty amperes per car for fifteen hours per day would be a fair average. $100 \times 20 \times 15 \times 365 = 10,950,000$ ampere hours per year. If all this went back to the generator by way of the earth, the decomposition of the rails every year would be 7,665,000 grammes, or about 17,000 lbs. of iron. Nearly eight tons lost from the mile of double track in one year. As the mile of 70 pound rails would only aggregate 220 tons, it would not be many years, at that rate, till the rails would be qualified for a pension for loss of both feet incurred in the service, and in time we might have an illustration of the proverbial "two streaks of rust and a right of way."

I have assumed an extreme case, but I have no doubt that there is a considerable amount of direct electrolysis of the rails. Nothing can be done to entirely avoid it, but it can be reduced to a minimum by overhauling the track circuit and giving it as great an electrical value as possible, and it might be retarded by dipping the rails before laying, similarly to gas and water mains. In abandoning as much as possible the rather uncertain supposed advantages of the earth return, we would, to a corresponding degree, rid ourselves of troubles with gas and water pipes and telephone circuits, and yet would be as safe from lightning as we are at present.

If it be admitted, then, that it is desirable to obtain from the track structure as great a conducting power as possible, the question arises, How shall it be done? This at once brings us to the subject of rail bonds, and a criticism of the various types used, with a view of arriving at the best from all points of view.

There have not been many types brought out by the manufacturers. Probably the earliest was made of a piece of wire having its ends coiled around two rivets and dipped in solder. This form is still much used, but it is objectionable. By its use four contacts exist at every rail joint, *i. e.*, rail to rivet, rivet to wire, wire to rivet and rivet to rail. To insure its position in the rail the rivet must be upset, and this in a great number of cases either starts or completely loosens the contact between the rivet and wire. If it escapes this, the constant vibration of the rail sooner or later causes loosening of the wire on the rivet. Once looseness occurs, the bond is of little use. Again, the essential nature of such a rail bond precludes the use of any large wire in its construction. Still, many roads have used them and are still doing so. The wire generally used is No. 4, B. & S., sometimes iron and sometimes copper.

Another type, which has met with much favor, consists of two soft iron pins with enlarged heads, which are drilled transversely to receive the connecting wire which is upset after passing through the heads. This form is open to the same objections as the previous one, being in three pieces, the integrity of whose contact is almost sure sooner or later to be destroyed, whether the intermediate wire is iron or copper.

Later on appeared the ingenious and, from a purely constructive aspect, very economical "channel pin." It met an enormous sale, and it is to-day in extensive use. The form is familiar to you, and I need not describe it. It requires three pieces, is not capable of rivetting in the rail, and its form prevents the pin and wire from completely filling the hole in the rail, and rapid corrosion of contact is inevitable. Being merely driven wedge-like into the rail hole its stay is not reliable, and by corrosion and continual vibration it becomes loose and almost valueless. There is, too, a tendency for the workman to force the wire against the sharpe edge of the hole while driving the pin, thus weakening the wire very materially. It, too, like the rivet-and-wire bond, has a limitation as to the size of the connecting wire. No matter how carefully the mechanics of the job are attended to, we have a mere plug driven in a hole, and so between the rail and channel pin and the car wheels is a very good illustration of a cask, a bung and a bung starter, with the odds against the bung.

Another type of rail bond is that composed of a piece of copper wire with cast copper rivets electrically welded thereto on projecting stems the size of the wire. This is an attempt in the right direction, but does not work out in practice. The electric weld is apparently uncertain, the union in many cases under my inspection being so imperfect that it could be broken by hand. The small copper castings exhibit radial crystallization, making welding difficult. Many also break in applying to the rails, and such happenings destroy confidence.

I now come to what is known as the "solid one piece bond," which has sprung into great favor. It would be disingenuous, were I not to announce right here, that this rail bond is a patented invention of my own, but I hope that you will admit that I am trying to view this question from a broad and disinterested standpoint.

This solid, one piece rail bond is simplicity itself. It is merely a wire with expansion curves at its ends on each of which a heavy shoulder is swaged from the wire itself, so that both the rivet ends thus formed and the intermediate wire are all one solid integral piece. From rivet to rivet there can be no failure of contact except by forcible rupture or total corrosion, and there can be no failure of contact between bond and rail, because when the rivet end is properly headed up, the connection made is perfectly watertight and airtight, and it is proof against pounding and vibration. There is no solder required, and no parts to shake loose, and there is no restriction in size of wire, as the bond can be made of No. 4 wire and it can be made of No. 0000, and larger if desired.

I suppose the great majority of rail bonds used span around the fish plates, which nowadays are quite long. My belief is, this is a mistake. Table III. will show what a difference there is in resistance in the track circuit as between 36 inch and 12 inch bonds. The 12 inch bond has the advantage in the total track re-

sistance of from 40 to 50 per cent. A 12 inch solid bond, with its expansion curves, makes a distance between rivet centres of about eight inches. Electrically considered, it does not matter what part of the rail end is used for bonding. The holes can be drilled through the flat "tram" or through the floor of the rail, four inches from the end just as readily as through the web or stem. There is no difficulty whatever, and I can imagine no type of track construction forbidding the use of short bonds. I have bonded many miles of track in this manner, and used the 12 inch bonds and had no trouble. In girder rail I prefer to drill the holes through the flat tram, taper ream the holes from above, and deeply countersink; then pass the rail bond up from beneath, and head up the ends till the taper and countersink are completely filled. This method has one great advantage, is allowing every rail bond to be inspected at any time without disturbing the paving. The tracks of the Atlantic Avenue Railroad in Brooklyn, were bonded in this way with No. 000 copper bonds, eight inches long between rivet centres, and they have given entire satisfaction.

Rail bonds should, after being applied, be either heavily coated with shellac and asphaltum, as practiced by Mr. Wason in Cleveland, or have a grooved strip of wood filled with asphaltum slipped around while the compound is soft. This will prevent corrosion.

Another important element of the return circuit, in such roads as do not pass the power house, is the main return. Whether earth circuit is used or not, there should be a heavy connection from the generator or switchboard by the shortest route to the rails. Such a course is generally adopted, but the size of the conductor is apt to be too small. I have seen several cases of serious inadequacy in this direction, so much, indeed, as to heat the main return. I had occasion once to discuss the question with a gentleman who called himself an electrical engineer, and who had engineered several railways of considerable size. The problem was to return a possible maximum of 5,000 amperes about half a mile from tracks to generator. I gave my views, which embodied rather heavy work, and also my calculations for loss of energy, etc. "Nonsense," said he, "four No. 0000 wires would be abundance, because you can lay them in the ground, and the heat will be carried off before harm can be done." It was no use arguing against that; and I utterly failed to persuade him that his four wires would require 320 volts to drive the 5,000 amperes through them, *i. e.*, a loss of over 2,100 electric horse-power. Fortunately that engineer has generally had some check on him, and thus the construction of several monstrosities has been avoided.

The old rails can be advantageously used for the main return in many cases. When it comes to using a large number of heavy copper wires overhead or underground on the one hand, and on the other hand an equivalent capacity of old rails laid underground, the latter is much cheaper, and can be made entirely durable. The rails can be connected by heavy copper plates by rivetting, the number of rivets being equal in carrying capacity to that of the rail and plate. The whole structure can be laid in a wooden trough filled with pitch, and will remain intact for an indefinite period. A 1-rail line of this kind, composed of old 60-pound flat or centre bearing rail, is as good as a copper bar one inch square, or six No. 0000 copper wires.

I am therefore, led to the conclusion that the best return circuit is that which complies with the following requirements:

1. Intrinsic resistance low enough to need no help from earth.
2. Utilization, to the utmost practical extent, of the rails as the return conductors.
3. Rail bonds of the heaviest practicable size.
4. Rail bonds of the shortest possible length, consistent with due allowance for expansion and vibration.
5. Rail bonds made of a single piece of wire with integral rivets.
6. Rail bonds tightly rivetted to the rails through holes freshly reamed immediately before bonding.
7. Rail bonds so placed as to permit convenient inspection.
8. Rail bonds protected against corrosion.
9. A very liberal use of heavy cross bonds from rail to rail direct, and, in double track, extra heavy cross bonds connecting the two inside rails.
10. An underground main or trunk return from power house to track, and there connected to each line of rails, and low enough in resistance to carry the maximum current with but a nominal drop in potential.

Not one of these requirements is an extravagance, but, on the contrary, their proper application to almost any electric railway in the country would be of immediate and lasting benefit. In new constructions they would be a positive economy in first cost. There is not one of them which cannot be adopted in practice, and it seems obvious that their complete embodiment in any existing road would be immediately noticeable in the power house, and eventually in the dividend.

NEARLY 15,000 SQUARE FEET of floor space has already been applied for by those who intend exhibiting at the Milwaukee Street Railway Convention beginning Oct. 18.

ELEVENTH ANNUAL MEETING OF THE NEW YORK STATE STREET RAILWAY ASSOCIATION.

THE eleventh annual meeting of the Street Railway Association of the State of New York was held in the rooms of the Chamber of Commerce, Rochester, New York, September 19, 1893.

The following delegates were present:

G. Tracy Rogers, president Binghamton Railroad Co., Binghamton; William Richardson, ex-president, and Wm. J. Richardson, Secretary Atlantic Avenue Railroad Company, Brooklyn, Henry M. Watson, president Buffalo Railroad Company, Buffalo; W. W. Cole, general manager West Side Railroad Company, Elmira; H. Bergholz, secretary and treasurer Ithaca Street Railway Company, Ithaca; D. B. Hasbrouck, secretary Houston, West Street and Pavonia Ferry Railroad Company, New York; C. A. Williams; secretary, William Rosborough, superintendent, and Albert Green, electrician Rochester Railway Company, Rochester; C. A. Derr, general superintendent Rochester Electric Railway Company, Rochester.

The following gentlemen were also present: H. W. Blake, *Street Railway Journal;* F. R. Colvin, THE ELECTRICAL ENGINEER; B. E. Greene, *Electricity;* W. J. Clark, General Electric Company, New York; J. S. Crider, Washington Carbon Company, Pittsburgh, Pa.; H. C. Evans, Johnson Company, New York; D. T. Evarts, general manager Simplex Electric Company, Boston; Thomas H. Fearey, General Electric Company, Buffalo; Arthur W. Field, Peckham Motor Truck and Wheel Company, Kingston; R. Gerry, American Iron and Steel Company, New York; H. J. McCormick, Shaffer Manufacturing Company, Rochester; Elmer P. Morris, General Electric Company, Indianapolis, Ind.; A. D. Newton, Eddy Manufacturing Company, Windsor, Conn.; J. F. Ostrom, Pennsylvania Steel Company, Philadelphia, Pa.; D. W. Pugh, John Stephenson Company, New York; John S. Pugh, Baltimore Car Wheel Works, Baltimore; F. C. Randall, J. G. Brill Company, Philadelphia; F. D. Russell, Rochester Car Wheel Works, Rochester; John Taylor, Taylor Electric Truck Company, Troy; A. C. Vosburgh, secretary New Process Raw Hide Company, Syracuse; H. W. Weller, General Electric Company, New York; C. B. Wyman, manager Central Electric Heating Company, New York; Charles J. Bissell, counsel, Rochester, and C. C. Woodworth, Rochester.

VICE-PRESIDENT HASBROUCK then made a very interesting address on the development of traveling facilities in New York since the early thirties, to which period his memory ran back.

The Report of the Executive Committee was presented. The report showed that five companies had joined during the year. Three companies had been consolidated with a member-company, leaving the present membership 28 companies. Reference was made to the subject of electric traction, in which the Committee said: "We are glad to note the rapid development of the overhead system in Brooklyn. An object lesson as to character of construction, equipment and operation by electricity is there being given to the country and the world at large that will do much to pave the way for the successful introduction of electric traction in those cities where it has not yet obtained its foothold."

The Committee congratulated the fraternity that during the last session of the State Legislature not a single bill aimed against the successful operation and conduct of the business had become a law. All that was asked for the business was that the same consideration and fair treatment be extended to it as to any other. "The street railway business is a delicate financial meter that indicates with certainty the financial condition of a people. In proportion to the prosperity of the people is our business successful; and the converse is equally true. Judged by this infallible test, therefore, we are assured that the worst of the financial troubles and business depression of the country is passing business." In closing the report, a fitting tribute was paid to the memory of the late John Stephenson.

The next business was the report of Mr. T. J. McTighe "Return Circuit for Electric Railways," which was read by the Secretary, and is printed elsewhere in this issue. It was followed by a brief discussion.

The Vice-President appointed Messrs. Watson, Richardson, Sr. and Williams the Nominating Committee.

The Committee recommended the following gentlemen as officers of the Association for the ensuing year: President, D. B. Hasbrouck, New York City; first vice-president, G. Tracy Rogers, Binghamton; second vice-president, James H. Moffit, Syracuse; secretary and treasurer, W. J. Richardson, Brooklyn. Executive Committee: John N. Beckley, Rochester; Daniel F. Lewis, Brooklyn; Charles Cleminshaw, Troy. They were all unanimously elected.

The Association then adjourned to meet in Syracuse, the third Tuesday in September, 1894.

Upon invitation of the Rochester Railway Company those in attendance at the meeting rode in the afternoon in special cars to the Bartholomay Brewing Company, where they inspected the plant and luncheon was served. They then went to Charlotte, Lake Ontario Beach, where a liberal dinner was provided at the Cottage Hotel, accompanied with orchestral music and singing.

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TROLLEY ACCIDENTS.

TWO columns of its valuable space are devoted by the *New York Herald* to a list of "trolley accidents" in Brooklyn, in which about one million dollars damages are asked for. We hardly like to say that the list is amusing, as there are some serious and avoidable casualties enumerated, but the fact remains that not one of the whole lot, so far as we can make out, is due to the trolley itself, while many are evidently due to the wanton carelessness of the complainants in crossing car tracks or trying to board moving cars. In one instance, a child was run down by an ice wagon whose driver was watching a distant electric car advance. This went on record, as usual, as a frightful trolley accident. One man wants $5,000 for getting his foot smashed to a jelly while jumping on a car in motion. Again the deadly trolley. A woman afar off from the cars coming gets rattled and falls into an excavation in the street. She asks $5,000 for her wounds and bruises inflicted by the trolley. And so it goes.

It is a pity the newspapers don't discriminate better. Only a few days ago a child 20 months old was run over by a storage battery car on Second avenue, and we are under the impression that many of the journals still attribute the accident to the deadly trolley. As a matter of fact, the accident could not have been avoided. The child, utterly neglected by its parents, was making mud pies behind an elevated railway post. It heard the car coming and darted out from behind the post, right under the advancing car. Who could prevent the accident under such circumstances? Three weeks before the accident happened we were informed by some of the people interested in the road that they had begged for police assistance in keeping the track clear of children, who swarmed all over it, danced in front of the cars, climbed on behind in troops, and reduced drivers and passengers to a condition of absolute nervous demoralization.

With storage, conduit or trolley roads, these accidents will happen indifferently, without much regard to the means of getting the current, except that as time goes on and some of the trolley work deteriorates, accidents from broken wires will become more numerous. Even then, we believe the electric systems will remain superior in safety to anything yet tried, as they are to-day. There can be no travel without risk, and steam travel at the present time, more than half a century old, is attended with enormous loss of life and property. The Board of Trade returns for England, show last year on the steam roads, with 864,435,388 passengers carried, exclusive of commuters, no fewer than 1,130 passengers and employees killed, and 4,485 injured. The loss of property and the capitalized loss of life are not given. Now the electric cars in America are already carrying at least as many passengers as all the steam roads in England, but we venture to question whether at their worst they will ever tell such a tale of horror as that thus recorded of that carefully and conservatively managed system on which for fifty years the constant effort has been made to minimize danger. As to this country, we will only quote from the *New York Times* of September 25, which says: "The record of railway accidents in the United States for the past month is really appalling and is probably without a precedent for many years." But the steam roads we must have, and no one travels any less, or tries to suppress them, because of the accidents.

We think it about time, anyhow, that the silly abuse by the newspapers of the motor man was stopped. He is trying conscientiously to do his duty, and our constant observation tells us that he is most anxious and watchful to avoid damage and danger. If the daily papers want a text, and a useful mission, let them call on the car motor manufacturing companies for improvements in methods of braking and control. The cars in use hardly come up to the possibilities in this direction afforded by the state of the art, and if the force of public opinion is to be used at all it should be brought to bear on that point. The great popularity of the trolley system, and the growing travel, have compelled the use of larger, heavier cars and a higher rate of speed; and we make bold to say that the companies turning out car motors have not brought their mechanism for control up to as high a degree of efficiency as they might have done. The local companies and the hard-worked motor men are probably making the best of what has been furnished them; but they would certainly be glad to lessen the number of avoidable accidents to which such mechanism unfortunately subjects them.

The Growth of the Institute.

AT the September meeting of the council of the American Institute of Electrical Engineers, no fewer than 48 new members were admitted, representing all parts of the profession; while the question of branches was again brought up urgently at the evening general meeting. This matter is a most important one, and we trust that for its own welfare, equally with that of the art, the Institute will wisely encourage the movement. New York should be but a chapter, like Philadelphia or Chicago or San Francisco or Lynn, so far as membership and meetings go. Aside from that, it is best to maintain a strong centralized organization, for which the old headquarters, managed by the indefatigable secretary, will serve admirably for many years to come.

LETTERS TO THE EDITOR.

THE ADVANCE IN INSURANCE RATES AT PROVIDENCE.

WHILE as a whole we agree with the editorial in THE ELECTRICAL ENGINEER of September 13, relating to advance in rates in Providence, R. I., we must call your attention to the example afforded by the article, showing that electrical papers are fully as liable to misrepresent insurance matters as insurance and secular papers are to misrepresent electrical matters. Almost every issue of an electrical journal contains some clipping from a secular paper in relation to the "deadly trolley," or something of that nature, which it holds up to ridicule, and quotes as an example of how incompetent the ordinary reporter is to deal with questions of electrical engineering. This editorial affords a similar opportunity to the daily papers, or the insurance papers to turn the tables on the electricians.

You quote the assessed valuation of real estate in Providence for the year 1892 at $114,656,860. From these figures, which must of necessity include *land*, which is never insured, and which undoubtedly includes *dwellings, private barns, churches* and risks occupied for *dwellings with not more than two stories*, all of which are entirely excepted from the 20 per cent. advance recently ordered in Providence, you build up the amount of premiums received by the companies with an assumed average rate, and also the amount that will be received in addition under this 20 per cent. advance, making the latter figures $171,985. If you deduct the value of the land and of churches, dwellings and private barns and buildings occupied as dwellings and stores you will readily see that you must take out a very large proportion of the assessed valuation of Providence which will mean a very large reduction in the figures given as the increased amount to be received by the insurance companies.

You also state that the principal reason given for this advance is the electrical hazard, and we think you are entirely mistaken in that respect. Providence has always been a low-rated city, and there are a hundred reasons why rates should be advanced there other than the electrical hazard, although it may be undoubtedly urged as one of them. While it may not be possible to convict a woman of murder in Massachusetts on the claim that if she did not commit the deed who did, we believe that the insurance companies, in view of the abnormal increase in losses in the last five years, which cannot be accounted for in any way except on the ground of the great increase of the use of electricity during the same period, are somewhat justified in connecting these two matters as cause and effect, especially when we know there is such an immense amount of extremely poor construction work going on. The insurance companies are endeavoring in every way to correct this trouble, but it will still continue as long as the electric light companies will furnish current to work done by incompetent parties and electric supply companies will furnish material to such parties. It rests very largely in the hands of the electrical interests to restore the confidence enjoyed by the insurance companies in the safety of electric light and power, and we would call your attention to the fact that the electrical interests were not confronted with the problem of convincing the insurance interests that electricity was safer than other means of lighting because the insurance interests started out with that idea and welcomed the introduction of the electric light, granting rebates, in some cases, where the sole use of this light was guaranteed; but from their experience they have been obliged to recede from that position, and feel that, on an average, the use of electric light and power throughout the country has increased rather than diminished the hazard. We believe the electrical papers can do much to aid the good work of proper and safe construction.

We note the illustrated article in THE ELECTRICAL ENGINEER on the wiring of the residence of Mrs. Strong, at Erie, Pa., and we should be pleased if such construction, or construction of a similar nature, could be required in every case, but we are not led to believe that strict requirements of that nature could be enforced, or would be welcomed by the electric light companies. We recently amended our rules so as to forbid the use of flexible cord for pendants in show windows, and upon reporting a dozen or fifteen risks in one of the larger cities in New England as being defective in this respect, the manager of the electric light company made a trip to Boston and begged us not to enforce the rule in that city, as it would mean the shutting off of all these lights, as their wiring was done free, and they could not afford to change the cord pendants to permanent fixtures. If the enforcement of a simple requirement like this so threatens the prosperity of an electric light company that the manager is obliged to make a trip of over one hundred miles to ask to be let off, you can easily imagine what would be the result of requiring work of the nature of that described in Mrs. Strong's house.

C. M. GODDARD, *Secretary*,
Underwriters' International Electric Association.

BOSTON, MASS., Sept. 14, 1893.

[The figures to which Mr. Goddard objects have been furnished us from Providence, and as they are quoted with approval by the local newspapers, we cannot but assume their accuracy. The interviews reported with local insurance men also appear to accept them as accurate, as to the amount insurable and insured. Moreover, all the interviews that have come under our notice place the odium of the advance in rates on electricity and on nothing else. We wish we could believe with Mr. Goddard that we are mistaken. But he admits that the prejudice exists, and points out very forcibly why it exists. We can only repeat that the way to disarm the criticisms on electricity is to deprive them of any basis.—EDS. E. E.]

MISCELLANEOUS.

RAPID TRANSFER OF A METROPOLITAN TELEPHONE EXCHANGE.—THE NEW EIGHTEENTH STREET TELEPHONE EXCHANGE.

AT the beginning of last week the Metropolitan Telephone and Telegraph Company transferred the service of its thousand subscribers in the Eighteenth street district from the exchange that formerly existed in the building at the southwesterly corner of Broadway and Eighteenth street to a newly equipped central office in the McIntyre Building, over the Sherman Bank, at the northeasterly corner of the same streets.

In carrying out this transfer, the Metropolitan Company has broken the record for such work—cut it in quarters in fact. It has usually been considered that to move a telephone central office from one building to another, in such a way as to secure results satisfactory to both the subscribers and the company, was an operation that, from first to last, should occupy about a year. In the present instance the work has been done in a few days over three months.

Such expedition is all the more remarkable when it is considered first, that the new quarters had been designed to serve as ordinary business offices without any thought of providing accommodation for a telephone exchange, and second, that moving from an old telephone exchange to a new one is a very different matter from changing houses or offices. In the latter cases one takes one's furniture and effects with one and gets them settled down in comfortable working order as quickly as circumstances will allow. In the former it is necessary to have the new scene of operation completely ready for occupancy and for work before making the move, so that the change from one "central" to its successor can be made instantaneously, without a minute's interruption of the service. This involves the construction, for every move of a telephone exchange, of a complete new central office equipment.

Fortunately for the telephone companies, they do not have to move their exchanges every May; but so rapid is the evolution of new apparatus and so pressing are the growth of business and the demand for improved service, that it has so far been found that a telephone central office equipment remains "up to date" but a very short time and that before it has reached the very modest age of five years it is altogether behind the times.

In the case of Eighteenth street, the life of the abandoned exchange was just one week less than four years and two months, and every item of the equipment of the new "central" is different from and an improvement on the appliances in use in the former office. In the construction of the new exchange many distinct improvements, designed to save time in operation and to increase the general efficiency of the service, have been introduced. Of these we hope to give a description at a later date.

Three months of high pressure work on the part of the Engineering and General Superintendent's departments of the Metropolitan Company resulted in the accomplishment of the transfer on the 10th instant. The entire service was changed over from the old office to the new in the tick of a clock, without hitch or trouble of any sort. The new switchboard has been in satisfactory operation since that date and the office has every appearance of having been in running order for months, while the entire outfit of the old exchange has been dismantled and removed to clear the space it occupied for a new tenant.

WIRING INSPECTION IN DETROIT.

ALL firms which string wires in the streets of Detroit have to secure a permit from the city electrician. There are 15 firms in the city in that business, and a notice has been sent to each in regard to the supervision to be exercised by the lighting commission.

THE BEACON CO. is very busy with its new non-infringing lamp, and is, it is said, placing some Western concerns under license to manufacture.

DISCUSSION ON MULTIPHASE MOTORS AND POWER TRANSMISSION AT THE INTERNATIONAL ELECTRICAL CONGRESS.—II.

PROF. FORBES (*continued*). I will speak of a few other possibilities immediately before us and within sight now, and which there can be little doubt will be available to us in the course of the next few years, but which it would be unwise entirely to depend upon at the present moment. Among these I include those commutating machines which have been given the name of "rotating transformer," a misleading term, but machines which commutate the alternating current into the continuous current by the rotation of the armature. This was first largely shown to the world at Frankfort, in 1891, and chiefly by the firm of Schuckert & Co., and has been largely introduced in America, for experimental purposes, and to show how thoroughly convenient they are; and there are several specimens of them at the World's Fair. These machines involve the rotation of a full sized armature with all the losses involved in the armature of a dynamo machine, and consequently they add to the general losses of the system a loss of some 10 or 15 per cent. This loss is undesirable. Remember that the sole function of these machines is to commutate the current, and it does seem to me that we ought to be able to devise a commutating machine which shall simply do the work without this great loss of power. A great many attempts have been made in this direction. It is a very desirable aim, in order that we may have machines at a distance from our generating station to handle our street railways, which at present are worked by continuous current. If we can carry our high tension alternating current to a distance, to Buffalo, to Rochester, to Utica, Syracuse, Albany, transform it down to a low pressure and then commutate it by a simple commutator that is not absorbing power to an appreciable extent, we have a valuable adjunct to our machinery. This is one of the possibilities which is almost certain to arrive in the course of the next few years, and which we must look forward to and not leave out of account.

Mr. Pollak has this morning shown us an extremely valuable and simple way of doing this.[1] As to the successful operation of it in practice many of us have still to learn a great deal. Other attempts have been made in the same direction by Hutin and Le Blanc in Paris and by various other inventors, but I may say that a commutator of a simple kind, not losing 15 per cent., is a thing which is going to come, and we must look forward to it, although we cannot depend upon the possibilities of the future in the organization of our schemes of the present.

Other things are likewise coming. You have heard of the numerous attempts that have been made to devise single phase alternating current motors which can be put upon our lighting circuits. These have hitherto been not an entire success. We have seen, however, lately, in Switzerland, the successful construction of such a motor which can be put even on such circuits as are ordinarily used for lighting purposes, and this even when the frequency of alternations amounts to 133 periods per second, as is very generally used in this country. Such motors have been produced which work efficiently on those circuits, but there are a large number of motors, which, although not quite successful on this high frequency, at some lower frequencies are very efficient and satisfactory.

By the by, there is also a type of machine which I proposed for adoption, as a possibility in the future, with alternating currents, in the year 1883, and that is the direct current motor with a laminated field, and that also has a certain amount of possibility in the future; at any rate, with lower frequency than what we have been using. There are some difficulties in its use, but such men as Eickemeyer, Prof. Anthony, Tesla and various others have been engaged upon work in this direction and it has promise for the future.

Now, another of those things which are promising for the future is the question of arc lighting. At the present moment we could use the alternate current for arc lighting. It is being used for arc lighting in Europe. At the present moment in this country it has not been so very largely used, and most of us are of opinion that the continuous current arc lamp is a more successful thing than the alternating current arc lamp. In the first places which have to be supplied from Niagara Falls for the purposes either of traction or of arc lighting, there are existing companies at present doing that work. They have steam engines driving their dynamos, generating currents for these street railways and for these arc lamps. What they want us to do first is to throw out the steam engines, and put in motors to drive these dynamos which they have there, but not to throw away their whole plant.

Mr. Ferranti has been at work during the last year in developing a combination of a transformer and a simple commutator which shall convert the alternating current into the continuous current, whose value is constant, a current of 10 amperes or 15 amperes or whatever we may fix upon. This commutator of his is not one of those commutating arrangements which we have seen here, but is simply a commutator which is not absorbing power to a large extent in an armature like the other machines. It is a simple commutator and it is working well, and I have the greatest hopes that it may be developed in the near future.

While telling you what we are doing at Niagara Falls, I have only felt that it was right that I should put before you these possibilities, because it is only proper that we should consider most carefully what developments are likely to take place in the next few years, and we ought to provide that the machinery which we put down shall not become obsolete. In the meantime, for reasons which I mentioned to you yesterday, we saw a decided preference among the different systems of polyphase transmission and transformers in favor of a system in which the lines are not interconnected. That system when most simply produced is the two-phase system with two independent circuits, one for each phase. We are going to have dynamos made in two phases, not only because we want to avail ourselves of all developments in this line of working that manufacturers can offer us, but also because we get our single phase circuits cheaper than if we built the machine with one phase instead of two phases. If we use only single phase motors there, we get a larger output from the same machine by building it for two phases than building with one phase. This was appreciated so early as 1879 by a man whose name we all honor so much in connection with the development of electrical work, M. Gramme. His first alternating current dynamos were in two phases, eight poles and two phases, with a revolving field and a fixed armature.

As to the motors, we shall be using synchronizing motors of single phase, polyphase motors, and sometimes, no doubt, converting into continuous current for street railways.

The paper of Mr. Pollak which was read yesterday[1] and which has been referred to, involves what I consider a most important point for electrical engineers to attend to, namely, the commutating of the alternating current to give us a continuous current. Every advocate of the continuous current that there ever has been, and there have been bigoted advocates, would have been convinced in favor of the alternating current dynamo, alternating current and transmission, if you could have told him that you would put a commutator at the far end instead of at the place where you generated your power.

There were a good many special features in connection with the Niagara project which rendered special features in the design of dynamo desirable, and which naturally will differentiate the dynamo which is to be used there from those which have been in more ordinary practice, but I venture to say that there will be no serious departure. One of the features is that we have a vertical shaft instead of a horizontal shaft. As you are all aware, the water of the Niagara river is taken off one mile above the Falls by a large canal which has been built. It is then taken by tunnels into the wheel pits and send down on pen stocks a depth of 140 feet to the turbines below. These turbines have been designed by the illustrious firm of Faesch & Picard, in Geneva, and have been constructed by the I. P. Morris Company, in Philadelphia, and will be delivered very shortly. The water, after passing through the turbines, is carried down through the great tunnel which has been built and which is an engineering work to be proud of. On the top of the turbines is a vertical shaft coming to the surface of the ground, and that shaft rotating at 250 revolutions a minute, causes the large dynamos to revolve directly on the same shaft without any gearing whatever and at the same speed.

It has been proposed in many cases to generate the current at low voltage and use a step-up transformer to create a higher voltage. There are two objections to this. The first is the cost of the transformer. The second is that we have the extra losses in the transformer. If it is possible to create the whole voltage that we require in the dynamo instead of in a transformer, we save the cost of a transformer, which is approximately, roughly speaking, about the cost of the dynamo, and we are saving some three per cent. of efficiency. Now, I do not know if every man realizes what that means until he begins to figure out what it is. It means 150 h. p. in each of our units. Our units are 5,000 h. p. That means so much more earning capacity to our plant. That means so much more rental to be taken in. Suppose you put it at $20 per annum, and 150 h. p.,—that is, $3,000 per annum is saved by saving that little three per cent. $3,000 per annum capitalized at five per cent. would be $60,000. When we reduce these things down to figures we see what value the simpler method is to us. Now, I maintain that by following the example set by Gramme, of having the armature fixed, we may have a little extra expense but nothing like the expense of putting in an extra transformer. You can build that dynamo to the same voltage that you are going to use with a transformer. The fixed armature becomes a thing as easy to handle and as safe to handle as the transformer itself, and you can introduce your very high pressure into that armature with the same safety that you can introduce it into the transformer.

As to the means of transmission, I may say that it has been an anxious consideration as to whether the transmission ought to take place by overhead conductors or by means of a subway. Also the question of laying underground cables in a conduit has been

1. See THE ELECTRICAL ENGINEER, p. 238; Sept. 13, 1893.

1. See THE ELECTRICAL ENGINEER, p. 229, Sept. 6, 1893.

considered. I distinguish between a subway and a conduit thus: I consider that a conduit is a place for putting cables in. I consider that a subway is a place for putting cables in where a man can walk along and inspect them. Obviously the most complete and satisfactory method would be to put a subway wherever you want to carry those high tension mains. The cheapest way is obviously to put a pole line all the distance; and the intermediate way is to put a conduit for cables underground. The intermediate way is, as often happens when we try to strike a mean course, disastrous. One of the greatest troubles which is likely to come to this work unless it is watched against with the greatest care, is that arising from the capacity of the line. It was said of the high tension transmission at 10,000 volts between Deptford and London, which was for so long a time an experiment, that there were two things to consider in connection with the cables; first, their capacity, and secondly, their incapacity. Their latter defect has, I am glad to say, according to the latest advices, disappeared entirely from knowledge acquired as to how to deal with the first defect. But capacity is always apt to lead to trouble, and consequently the work will be done either by overhead conductors, bare wires, or by bare wires carried in a subway. Naturally the cost of a subway to Buffalo is a very serious thing. The first place which we have to supply with power is the Pittsburgh Reduction Company, in the manufacture of their aluminum, at a distance of 2,500 feet from the power house, and we have also to proceed almost immediately to Buffalo. Later on we have to meet the agreements which have been made to supply places situated along the Erie Canal, and since the State of New York has taken up experiments on the possibility of having their towage on the Erie Canal conducted by means of electricity, we have to consider the question of transmitting electricity over the whole of that distance. I may express as a purely personal opinion that the action of the State of New York in this direction is an action of the very highest importance; that it is likely to revolutionize traffic in the State of New York; that the volume of transportation over the Erie Canal will be such as to benefit manufacturers in all parts of the State, and more especially those in the neighborhood of Buffalo and the Falls.

I have lately had occasion to deal with a similar problem in India. The Indian Government has lately been irrigating the eastern side of the Nilgherry Hills by means of the rivers on the western side of these hills, and driving a tunnel through the mountains to carry water to irrigate land. They found that when the water was carried through the tunnel at an elevation of 1,200 feet, within a mile and a half before they wanted to begin to use that water for irrigating purposes, they had sufficient head of water to develop 50,000 h. p. They have been considering the question of generating electricity and I have had to look into the electrical question. In that case the greatest development of electrical power and lighting would be at the town of Madras, which is 850 miles from the spot, but still, according to the best information that we are able to collect on what has been done at high voltage, it seems almost certain that this power can be carried that distance and delivered at Madras as one of the cheapest forms of power in the world, because all the hydraulic works are already created and their sluice gates and everything prepared, and they are simply putting in the transmission plant.

The transmission from Niagara Falls to Albany is almost identical with this. The distance is the same, and when we come to supply this canal we shall have to consider the question whether overhead poles are possible. In the meantime it will be desirable to have some experiments made upon overhead construction, because in this climate there are very great difficulties. The two most serious difficulties that have to be contended with in connection with transmission for an overhead line are first, those due to lighting, and second, those due to sleet. The sleet trouble is a very serious one, especially in the northern climate. Broadly speaking, the conclusion which it seems we must arrive at is, that a transmission by overhead conductors must, in the nature of things in that climate be liable to occasional interruptions, and that the electrical subway is almost certain to be carried out without interruptions, giving a continuous service. This makes one naturally favor the subway system. But experiments will be carried out with the pole system undoubtedly, and I have to conclude by making one statement which I think ought to be a matter of congratulation to all of us who are interested in seeing such a scheme successful, and that is that a subway, at any part of the way, has been begun. Last Friday the first sod was turned for a subway which is going to carry the conductors from the power station at least so far as the Pittsburgh Reduction Works, which is half a mile distant from the power house. (Applause).

THE ROYAL ARC CO. have barely yet entered the field with their very promising Howard incandescent arc lamp, but are already inundated with inquiries and correspondence of all kinds in regard to it. A new feature has developed, namely, the high approval shown it by insurance men because of the absolute and perfect enclosure of the arc. We understand that a street circuit of these lamps, in a city on the Jersey coast, went through a heavy thunderstorm last week in a most successful manner, and much to the satisfaction of the superintendent.

SOCIETY AND CLUB NOTES.

THE AMERICAN STREET RAILWAY ASSOCIATION MEETING AT MILWAUKEE, WIS.

THE twelfth regular (annual) meeting of the American Street Railway Association will be held in the hall of Exposition Building, Milwaukee, Wis., the third Wednesday in October (the 18th), 1893, commencing at 10 o'clock, a. m., and continuing three days.

The following is a general programme of the meeting:—*Reports of Special Committees. Special Committees will report on the following subjects:* "Best Method of Lighting and Heating Street Railway Cars;" "Can the T rail be Satisfactorily Used in Paved Streets?" "Direct Driven Generators;" "Power house Engines;" "Standard Form for Street Railway Accounts;" "Standards for Electric Street Railways;" and "Storage Batteries in Connection with Central Stations for Utilizing Surplus Energy for Lighting or Power." Notice has been received by the secretary that a special paper will be read on the following subject: "Some Practical Points in the Construction of Underground Feeders."

The executive committee has secured the Milwaukee Industrial Exposition Building for the exhibition of supplies and manufactures of every nature used in the street railway business. It has been engaged for two entire weeks, beginning October 9th, and ending October 23d; thereby giving ample time for the setting up and removal of the largest and heaviest exhibits. The hall for the meeting is also in the same building on the second floor, and delegates will therefore be enabled to examine the exhibits with much greater satisfaction than heretofore. The exposition will be in charge of the secretary, assisted by Mr. A. Trumpff, secretary of the Milwaukee Industrial Exposition Association.

The Milwaukee Street Railway Company proposes to entertain all who attend the meeting, in a way to be remembered.

In consequence of the World's Fair being at Chicago, most of the traffic associations will make no other concessions than their so-called World's Fair rates for all meetings held at Chicago, or places in its vicinity. The Western Passenger Association, in whose territory Milwaukee is located, has granted the courtesy of a fare and one-third for the round trip to all, including friends and members of the families of all in attendance at the convention, whether delegates, supplymen or others. This reduced rate becomes effective only when evidence is presented to the joint agent of the terminal lines at Milwaukee, showing that 250 persons have actually been in attendance holding certificates.

UNDERWRITERS' INTERNATIONAL ELECTRIC ASSOCIATION.

A MEETING of the sub-committee appointed at the meeting of the Electrical Committee of this Association recently held in Chicago was held at the Exchange Rooms of the New England Insurance Exchange, Boston, Mass., on Sept. 5, 6 and 7 to consider certain matters referred to them by the Chicago meeting, and also to define the word "approved" as used in the present Underwriters' rules.

The committee consisted of F. E. Cabot, superintendent of the Survey and Electrical Department of the Boston Board of Fire Underwriters; Geo. P. Low, electrician of the "Pacific Insurance Union;" E. A. Fitzgerald, electrical inspector of the Underwriters' Association of New York state; Wm. H. Merrill, Jr., electrician of the Chicago Fire Underwriters' Association; A. E. Van Geisen, electrical inspector of the New York Board of Fire Underwriters. All of the above gentlemen were present, as were also Mr. Geo. W. Wilson, electrical inspector of the Boston Board of Fire Underwriters, J. Coulliard, electrical inspector and C. M. Goddard, secretary and electrician of the New England Insurance Exchange.

The principal work of the committee was considering what forms of insulation for wires, and materials for fittings would be approved by the association; the drawing up of rules for the introduction of automatic fire alarm systems, and considering a few amendments to the rules which were referred to them by the meeting at Chicago. All their recommendations on these points will be submitted to the remaining members of the electrical committee for approval, after which the work of the committee will be put in shape and forwarded to the Underwriters' organizations in the United States, and given to the press for publication, if they desire it.

By invitation the committee visited the laboratory of the American Bell Telephone Company, and examined devices for protection of telephone and other wires against abnormal current. By courtesy of Mr. A. E. Bliss, general manager of the Malden Electric Light Company, the committee visited the station at Malden, Mass., and were allowed the use of their 500 volt dynamo for testing various forms of cut-outs for high potential circuits.

The experience of the various members of the committee and the fact that the amendments to the rules now in force are very few, are convincing proofs that the work of the committee and

the association thus far has been extremely successful, and that the rules recommended by them have been found satisfactory to the insurance and electrical interests.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE 1893–94 season of the Institute opened at the House, 12 West Thirty-first street, on Sept. 20, with a very large attendance. The council met during the afternoon and admitted no fewer than 48 new members. The first business of the evening was an admirable little paper by D. McF. Moore on "A New Method of Controlling Electric Energy," in which he detailed some experiments with an interrupter in a vacuum, etc. This was followed by the inaugural address of President Houston, dealing with the work of the recent Congress and criticizing some of the results. Mr. W. H. Preece followed with an extremely happy address which was enthusiastically applauded. A brief discussion followed as to the establishment of branches or chapters of the Institute, the place specially in point being Lynn.

PHONOGRAPH MEN IN SESSION.

THE fourth annual convention of the National Phonographic Association was held last week at the Victoria Hotel, Chicago. There was a good attendance of delegates from almost every state. Officers for the ensuing 12 months were elected as follows: President, Maj. A. W. Clancy, Chicago; vice-president, Ed. Benson, Omaha; secretary, W. S. Gray, Chicago; treasurer, R. T. Haines, New York.

THE FRANKLIN ELECTRICAL SOCIETY has begun to hold its meetings for the season. Anyone interested in electricity and magnetism and desiring to become a member should send an application to the president, Mr. E. V. Lallier, 89 Liberty street, this city.

REPORTS OF COMPANIES.

ALEXANDER, BARNEY & CHAPIN.

DEPUTY SHERIFF FINN has received an execution for $16,549 against Alexander, Barney & Chapin in favor of Patrick Gray, on assigned claims of Luke A. Burke. The business was incorporated in November, 1890, with a capital stock of $100,000. Luke A. Burke, a builder, obtained control of the company in 1891, becoming vice-president, and Messrs. Alexander, Barney & Chapin retired from the concern. The annual report last January said the liabilities did not exceed $65,000, and the assets were worth $75,000.

PERSONAL.

PROF. W. A. ANTHONY.

WE are glad to note that Prof. W. A. Anthony has entered the general field of expert work once more, so that his services in consultation and report may be availed of by the profession and industry at large. He can be addressed at Manchester, Conn. His familiarity with the whole range of theoretical and applied electricity is so well known that we deem it unnecessary to refer further to the matter beyond expressing our pleasure at being able to make this interesting and important announcement.

MR. WILLIAM A. COURTLAND, many of whose excellent drawings have illustrated the pages of THE ELECTRICAL ENGINEER during the past three years, has opened a large draughting room at 87 Nassau street, New York City. Mr. Courtland has had 15 years' experience as a patent office draughtsman, six of which have been spent in this city, and he is assisted by an able staff whose range of ability covers the entire field. His attention has been largely devoted to electrical drawings, and the ENGINEER'S striking illustrations of the famous Tesla lecture at Columbia College bear witness, among others, to his skill in combining artistic effect with mechanical accuracy of detail.

MR. GILBERT WILKES, formerly of the U. S. Navy and more lately of the Edison General Electric Co. and Detroit Electrical Works, has established himself as a consulting electrical engineer at 149 Griswold street, Detroit. His large experience in all classes of construction and installation work, renders his services specially valuable and desirable.

OBITUARY.

MR. C. O. ROWE, superintendent of the Western Union Eighth District, with headquarters at Pittsburgh, died on Sept. 12, at Titusville, Pa., from heart disease. He was born in 1840. He leaves a widow and four children, his wife being a cousin of Stonewall Jackson.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPTEMBER 5, 1893.

Accumulators:—

Secondary Battery, W. L. Silvey, Lima, O., 504,370. Filed July 8, 1892.
Employs plates with perforations filled with oxide of lead in the form of dry powder; the plates being then united by means of a solution containing sulphuric acid and afterward formed in another solution.

Storage Battery, C. J. Reed, Orange, N. J., 504,455. Filed March 2, 1893.
Consists in forming an active coating on the opposite faces of a sheet of conducting material, cutting grooves in the coatings and afterward cutting it into strips of the desired width.

Alarms and Signals:—

Call Box, H. H. Cutler, Waltham, Mass., 504,488. Filed Jan. 13, 1893.
Invention relates to special methods of construction in a call box for district messenger service.

Electric Railway Signal, F. E. Seagrave, Toledo, O., 504,542. Filed Jan. 26, 1892.
An electric signaling system especially designed for single tracks of steam railway, that approaching trains may be automatically warned of each others' proximity (see THE ELECTRICAL ENGINEER, August 16).

Conductors, Conduits, and Insulators:—

Electric Conductor, J. W. Marsh, Pittsburgh, Pa., 504,397. Filed August 8, 1892.
Claim 1 follows:
An electric conductor having a covering of paper moulded thereon with air spaces formed in said covering.

Electric Conductor, J. W. Marsh, Pittsburgh, Pa., 504,398. Filed Aug. 8, 1892.
Employs an insulating covering of paper supported by a cushion on the conductor.

Wire Splicer, J. D. Thomas, Scranton, Pa., 504,638. Filed April 21, 1893.
Consists of a tube with apertures through which are inserted serrated wedges adapted to bind between the wire and the tube.

Distribution:—

Electric Car Lighting System, I. N. Lewis, Fort Wadsworth, N. Y., 504,681. Filed Sept. 17, 1892.
Employs simultaneously a dynamo, a storage battery and a lighting or power circuit connected with the car axle.

Dynamos and Motors:—

Commutator for Dynamo Electric Machines, E. P. Warner, Chicago, Ill., 504,379. Filed Nov. 1, 1892.
Employs two supports for the commutator bars near their ends so mounted upon the shaft as to be free to move longitudinally and independently of one another.

Armature for Dynamo Electric Machines, J. T. Morrow, Lynn, Mass., 504,401. Filed May 13, 1893.
Relates to the building up of a laminated core and securing it upon its support.

Method of and Apparatus for Regulating Alternating Current Dynamos, H. Lemp, Lynn, Mass., 504,497. Filed Jan. 19, 1891.
Invention consists in producing the required variations in the excitation of the dynamo by variations in a regulating resistance, the resisting conductor of which is heated by the alternating current of the machine.

Method of Operating Electric Motors by Alternating Currents, A. Siemens, London, Eng., 504,630. Filed Oct. 21, 1890.
The method consists in generating an alternating current, transmitting it to a local point of consumption and there producing in a motive device a succession of alternating polarities in the respective elements of such device so as to maintain their relation with same although their absolute polarity change.

Lamps and Appurtenances:—

Pendant Incandescent Electric Light, W. A. Johnston and J. C. Davidson, Prince's Bay, N. Y., 504,475. Filed April 28, 1893.

Electric Arc Lighting System, T. Spencer, Philadelphia, Pa., 504,632. Filed Feb. 18, 1893.
Consists in the initial application to the lamp of a current having a potential greater than that for ordinary working.

Metal Working:—

Electric Welding Apparatus, H. Lemp, Lynn, Mass., 504,496. Filed June 25, 1890.
Invention consists in means for operating the movable slide of the work holder through the pressure of fluid, and in devices whereby the pressure may be regulated according to the nature of the work.

Electrically-heated Soldering-Iron, G. R. Meitzler, Cincinnati, O., 11,364. Reissued. Filed July 3, 1893.

Miscellaneous:—

Electric Belt, W. C. Ekholm, Joliet, Ill., 504,336. Filed June 19, 1893.

Electric Lock, L. B. Tinkham, Quincy, Mass., 504,462. Filed May 12, 1892.

Electric Automatic Steam Governor, E. A. Edwards, Cincinnati, O., 504,492. Filed Dec. 2, 1891.

Flash Light Apparatus for Photographer's Use, J. N. and H. J. Harrison, San Francisco, Cal., 504,578. Filed June 8, 1891.

Musical Instrument, C. Doriot, Philadelphia, Pa., 504,671. Filed April 17, 1893.

Railways and Appliances:—

Trolley Wire Cleaner, M. Shaaber, Reading, Pa., 504,405. Filed June 19, 1893.
A scraper carried on the trolley pole just ahead of the point of contact between the trolley and the wire.

Electric Locomotive, A. I. Ambler, Washington, D. C., 504,484. Filed Sept. 16, 1892.
Employs a motor whose shaft extends longitudinally beneath the car and is geared by worm gearings to the two axles through the medium of friction clutches.

Conduit Electric Railway, B. Bidwell, Philadelphia, Pa., 504,549. Filed Sept. 4, 1884.
A conduit having an open top, internal brackets secured to the opposite vertical sides and having their ends flush with the top of the conduit, stationary conductor sections supported by the brackets and a slotted cover made of two removable sections

Conduit for Electric Railways, S. H. Flagg, Providence, R. I., 504,676. Filed Aug. 24, 1892.
Consists of a large pipe of metal with a slot at its upper side containing a pipe of cast glass also slotted and arranged at one side of the metal pipe.

Switches and Cut-Outs:—

Thermal Out-Out, W. M. Goodridge, Highland Park, Ill., 504,344. Filed Nov. 19, 1887.

Double-Pole Switch, C. W. Gartside and R. E. Wood. Baltimore, Md., 504,523. Filed June 29, 1893.

A push-button switch employing a rocking lever pivotted between the poles.

Electric Switch, A. B. Herrick, Schenectady, N. Y., 504,528. Filed July 21, 1892.

A knife-blade switch for very heavy currents.

Telephones and Apparatus:—

Multiple-Switchboard Apparatus, W. M. Goodridge, Highland Park, Ill., 504,345. Filed Jan. 12, 1889.

Provides ready means for making the connections and disconnections between telephone lines at the central office.

Telephone Transmitter, N. Parks, Deansville, N. Y., 504,454. Filed Dec. 6, 1892.

Emp'o'a a b'ock of carbon having recesses in its opposite sides and electrodes loosely entering the recesses and carrying the block.

Switchboard for Telephoning Purposes, U. H. Balsley, Philadelphia, Pa. 504,464. Filed June 8, 1889.

Telephone Apparatus, A. Stromberg and A. Carlson, Chicago, Ill., 504,636. Filed Apr. 3, 1893.

Has for its object to provide a magnetic telephone of increased power which may be used as a transmitter.

Telegraph:—

Condenser Telegraph System, C. H. Rudd, Evanston, Ill., 504,367. Filed Feb. 8, 1889.

Legal Notes.

USHER STORAGE BATTERY DECISION.

INJUNCTION GRANTED THE BRUSH ELECTRIC COMPANY AND THE CONSOLIDATED ELECTRIC STORAGE COMPANY AGAINST THE MILFORD AND HOPEDALE STREET RAILWAY COMPANY, *et al.*

A DECISION against the defendants was granted by Judge Colt, in Boston, on September 21, Messrs. Charles E. Mitchell and Witter & Kenyon appearing for the complainants and Messrs. Wetmore & Jenner for the defendants, in the injunction suit brought by the Consolidated Electric Storage Company, through the Brush Electric Company, against the Milford & Hopedale Street Railway Company.

In his opinion the Court stated that the Brush patent had already been sustained by the courts in several cases and that the question presented was, therefore, whether the defendants' battery was within the Brush patent. The patent in suit, he said, was for the broad invention. This consists of a secondary battery electrode in which the active material is mechanically applied to a support-plate. The Brush invention is simple and easily understood. There is (1) the supporting plate, (2) the active material mechanically applied thereto, (3) the active material held to the plate by pressure, or by a sheet of porous, non-conducting material. It is the combination of these elements in the formation of a secondary battery which is covered by the patent in suit. By this means Brush produced the first commercial storage battery ever made.

The Usher battery, used by defendants, consists of a plate in the form of a rectangular frame or grid, with vertical and horizontal ribs. Enclosed and held between the ribs are packages of active material in the form of powdered oxide of lead, commercially known as red lead, having a wrapping of thin sheet lead. The wrapping is perforated and the perforations are filled with gum. Thin sheets of kiln dried wood separate the plates. The plates and sheets are held together by rubber bands, and are set in a receptacle of hard rubber containing dilute sulphuric acid.

In structure certainly this battery appears to have the elements of the Brush invention—a support plate combined with mechanically applied active material, the plates being separated by sheets of porous non-conducting material.

It is insisted, however, by defendants, that the plate of the Usher battery is not a support-plate. But why, it is difficult to see. It certainly acts as a support for the active material. When the packages of red lead are inserted in the receptacles of this plate they come in contact with and are held by the ribs of the plate. In his patent of August 16, 1892, Usher says: "I first prepare a metallic skeleton plate." This plate has two functions—to support the active material, and to conduct the current. It is not analogous to the conducting plate of a vessel support battery where the active material is placed in and supported by a vessel. Usher starts to build his battery with a plate, and then proceeds to support his material upon it just as Brush does. He does not take a vessel and pour his active material into it. Support, in the sense of the Brush patent, does not mean that the active material must be wholly supported on the surface of the plate in the form of a coating as in the case of a plain plate. The patent expressly refers to receptacled or slotted plates as well as plain plates, and declares that the active material "may be primarily coated or combined" therewith. The word "combined" in the Brush patent is entitled to the same consideration as the word "coated," and it would be just as unreasonable to eliminate one as the other from the patent.

To the Court's mind it is clear that the skeleton plate of the Usher battery is a support plate within the meaning and language of the Brush patent, and that it is constructed and used for identically the same purposes as the Brush plate.

Again, the Usher plates are separated by sheets of porous material in the form of kiln dried wood. These sheets help to support the active material upon the plates just as the sheets of porous blotting paper in the Brush battery. Brush does not confine the use of this porous medium to plain plates, but specifically states that it may be used with receptacled plates. The fact that the Brush battery of commerce is constructed without this porous medium, and that this is considered an inferior form of construction, does not make it any less a part of the Brush invention.

In thé Brush battery as ordinarily constructed, the active material is applied to the plate by pressure. This leads the defendants to declare that the Brush invention is limited to the use of some kind of pressure, and that Usher does not use any pressure. A glance at the Brush patent shows the unsoundness of this contention. He states in his patent that the active material may be applied to the plates in two ways, by interposing a sheet of porous material between the plates, or by spreading a quantity of material upon the plate and applying pressure, in which case no porous medium is necessary.

It is further urged by defendants that the active material of the Usher battery is new and unknown before, and that it is not the active material of the Brush battery. They assert that the oxide of lead in the Usher battery does not become the active material of the battery until it has passed through their forming or charging process when it developes into a new and powerful peroxide. This is the only way they can account for the superior efficiency of the Usher battery.

The answer to this is that when the defendants take a quantity of finely divided oxide of lead such as Planté produced by the disintegration of the plate, and which is known and understood in the art as active material, and apply it directly to a supporting plate to form the electrode of a secondary battery they have appropriated the invention of Brush, and it is useless for the purposes of this case to make any further inquiry. But it is significant in this connection that Usher, in his two patents for improved storage batteries, introduced in evidence by plaintiffs, calls the oxide of lead contained in his packages "active material." The only difference in this particular between Usher and Brush is that the former encloses his active material in perforated lead wrappings. This may or may not be an improvement. As to the theory of a new active material I am inclined to believe, that the Usher battery does not develop any new peroxide, and that the phenomena of gradually increasing power and greater ultimate efficiency which are said to characterize its operation are due to the obstruction which is offered to the action of the electrolyte by the lead covering surrounding the active material and the use of a greater quantity of such material in the packages. This hypothesis is at least more reasonable than to suppose that some unknown chemical action takes place which is foreign to the Brush battery.

INCANDESCENT LAMP SUITS IN NEW YORK CITY—INJUNCTIONS GRANTED.

JUDGE LACOMBE of the United States Circuit Court, New York, granted a preliminary injunction on Sept. 19, to the Edison Electric Light Company and the Edison Illuminating Company, restraining the Mount Morris Electric Light Company and the United Electric Light and Power Company from using incandescent electric lamps infringing upon the Edison patents. Judge Lacombe said that he would not interfere with the lights at present in use, but would give a reasonable time for a change to non-infringing lamps. An appeal from Judge Lacombe's decision will be taken to the Circuit Court of Appeals.

A FEAT ON THE INTRAMURAL.

FOR some time the managers of the Intramural Railway at the World's Fair have felt that the road could operate much longer and heavier trains than the ordinary ones, and last week it was determined to make a trial. The result proved satisfactory from every point of view.

Mr. W. E. Baker, manager of the road, late at night started out a train composed of one live motor car, two still motor cars and nine empty cars. This train weighing altogether in the neighborhood of 196 tons was pulled along by the motors apparently without any greater effort than the ordinary train and turned the curves without any difficulty. This feat may be appreciated when we say that as the train turned the loops at either end of the road, each of which has a radius of about 100 feet, the persons in the last car could easily have shaken hands with those in the first.

This trial having resulted successfully, and the following day being Railroad Day, when the railroad magnates assembled at the Exposition, invitations were issued to them to ride on the Intramural, and a train of eight cars—one motor and seven trailers—was provided. The train of eight cars was loaded to its fullest capacity, not less than 800 persons being carried, and the trip was

made from the Transportation Building along the entire length of the line, and back. The motors ran smoothly and without a hitch at their maximum speed, and expressions of satisfaction at their operation were heard on all sides from the steam railroad men. The weight of this train can be conservatively estimated as follows:

1 motor car..........................	22 tons.
7 trailers, 13½ tons each...............	94½ "
800 persons averaging 120 pounds each.........	96 "
Total....	212½ tons.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PORTER ADJUSTER FOR INCANDESCENT LAMPS.

We illustrate herewith a new light adjuster for incandescent lamps just brought out, and which has many features of novelty and merit.

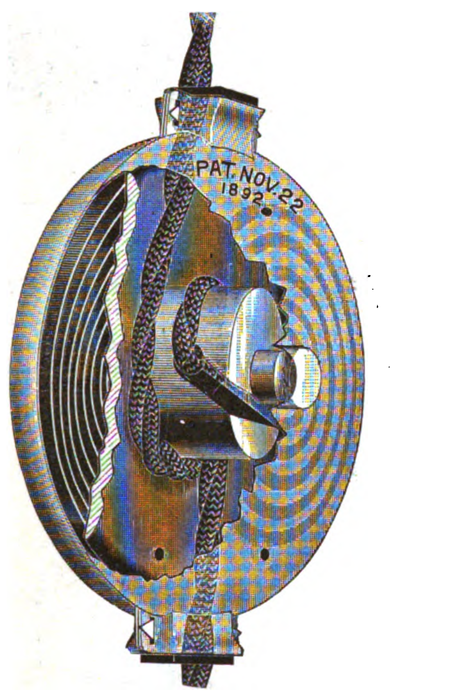
This adjuster can be attached in one minute without detaching the cord from the lamp socket or rosette. It is made in unique design, very light and compact and has no heavy weight for the cord to support. Every adjuster is carefully inspected before leaving the factory, to see that it is in proper working order, and is warranted in every respect.

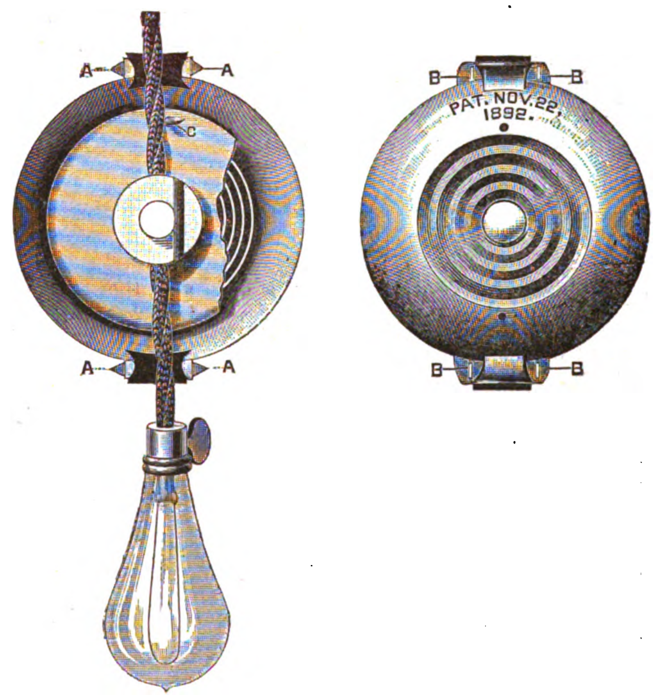
Fig. 1 shows the adjuster attached in position on the cord with a part of the brass shell broken away showing the wood spindle with the cord slot through which it passes with the cord in position, the flange on the wood spindle being partly broken away to show a portion of the regulating spring.

Fig. 2 shows the adjuster with one-half the brass shell removed, each half of the shell being made of brass and stamped up to proper shape. One of the halves has four slots marked B, and the other has four V-shaped points marked A. The wood spindle is secured to the latter so that it cannot be displaced while being attached to the cord.

In use, the cord is pressed to the back of the slot in the wood spindle. Then the shell is placed, with the B slots in position so that the four V-points A extend through the slots B, and then the points A are bent down. This holds the halves together firmly. Then pin C is removed and the adjuster is ready for use. The spring should be regulated to the desired tension before attaching. This can be determined by holding the halves together with the hand and working up and down before bending down the four V-shaped points which hold the halves together. If the adjuster requires to be moved up or down on the cord after being attached, the lamp is simply pulled well down with one hand and the adjuster is moved to the proper position. The cord will slip through the slot in the wood spindle without injury.

The adjuster is made in two sizes by Stephen Porter & Co., 384 Atlantic avenue, Boston, Mass. The No. 1 size adjusts from 0 to 30 inches and No. 2 size from 0 to 9 feet.





Figs. 1 and 2.—Porter Adjuster for Incandescent Lamps.

MR. S. W. RUSHMORE.

Mr. S. W. Rushmore, inventor of the Rushmore arc lamp and for some time connected with the Excelsior Electric Company, has secured the services of a number of highly skilled workmen, and has now opened a factory at 24 Morris street, Jersey City, N. J., and an office at 89 Liberty street, this city. The factory is well equipped for construction and repair work of all classes, and the manufacture of dynamo supplies, commutators, etc. Mr. Rushmore himself is an electrical engineer of ability and will devote much of his time to expert inspection and superintendence.

MORE LA ROCHE PLANTS.

Among some of the most recent plants installed by the La Roche Electrical Works of Philadelphia, is the hotel plant for McLure Bros., Wheeling, W. Va.; W. H. Miller, Memphis, Tenn.; Gloucester Ferry Co., Gloucester, N. J.; Nazareth Manufacturing Co., Nazareth, Pa.; Roesh Butcher Works, and Allegheny Woolen Mills, Philadelphia.

The company is now established in its new seven story factory at American and Diamond streets, and prepared to fill orders quickly for the large apparatus it is now building. The equipment of the factory is first-class in every respect, and the plant is equal to the construction of generators of the largest capacity.

THE CHESLEY ELECTRIC COMPANY.

The Chesley Electric Company, of Jersey City, have purchased the building Nos. 601–605 Newark street, Hoboken, N. J., and will remove there Oct. 1st, having outgrown their present quarters. The building is 60 by 70 feet, and will be heated by steam. They will have 500 volt current for power purposes and ordinary testing, and alternating current for lighting, the primary being also used for testing alternating armatures and converters.

This company also buy and sell second-hand apparatus and with their increased facilities ought to do a flourishing business.

Their new location is an excellent shipping point as it is convenient to all railways and water routes to New York.

Mr. Frank R Ford, M. E., formerly the Chicago manger of the Short Electric Company, has accepted the position of general sales agent of the La Roche Electrical Works, Philadelphia.

THE DODGE MANUFACTURING CO.'S APPARATUS.

THE DODGE MANUFACTURING COMPANY was founded by W. H. Dodge, in the year 1878, for the manufacture of wood hardware specialties. In 1879 a lumber department was added, and the manufacture of fine lumber became an important part of the business. In the year of 1880 a stock company was organized, and the entire establishment was destroyed by fire in 1881, but was immediately rebuilt.

From that time on the business has increased very rapidly. Extension after extension has been made to the works until it is now one of the most complete manufacturing plants in the world, occupying about sixty acres of ground. The floorage of the factory buildings and warehouses alone amounts to sixteen acres.

The buildings are all constructed of brick and stone, and the slow burning plan has been employed, heavy timbers being used for joists and the floors being four inches thick. Over 8,000 automatic sprinklers are used for fire protection.

After the destruction of the works by fire, in 1881, certain pulleys were constructed of wood, with the bushing system, and they proved so satisfactory that it was decided to make the wood pulley the main feature of manufacture. This was the inception and origin of the Dodge Independence patent wood split pulley with patent bushing system, now so familiar to our readers.

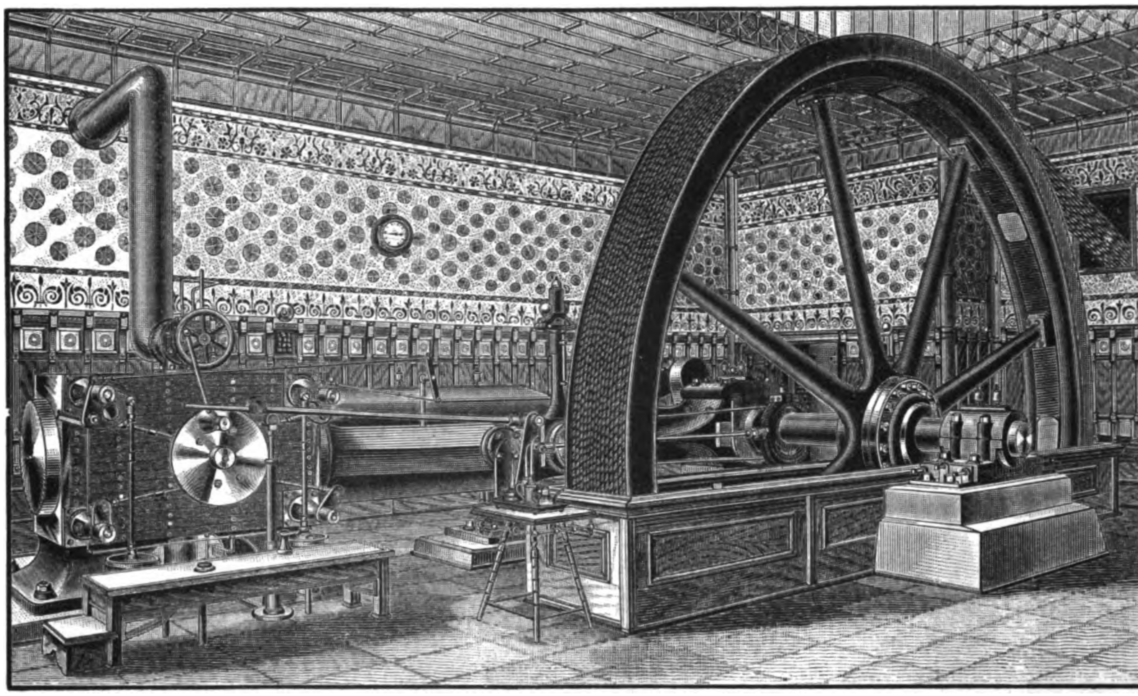


FIG. 1.—ENGINE ROOM IN DODGE FACTORY.

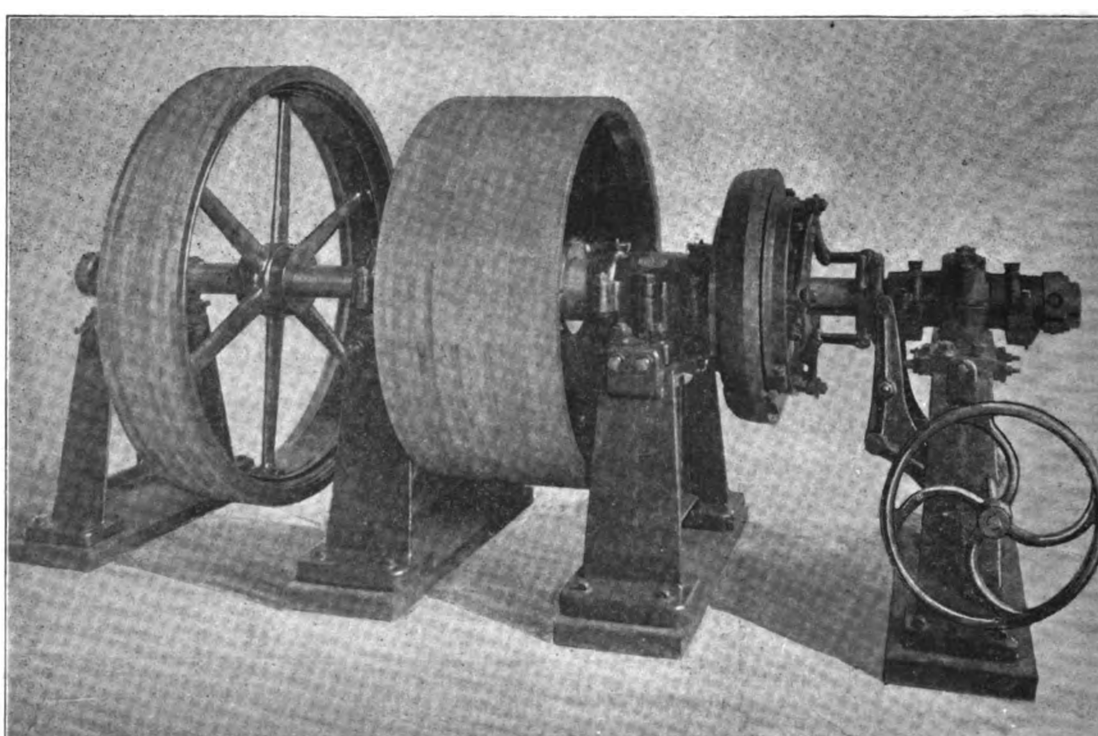


FIG. 2.—DODGE FRICTION QUILL.

Fig. 1, of the accompanying illustrations shows a portion of one of the engine rooms in the works of the company, at Mishawaka, Indiana. Aside from elegance and neatness, the most interesting feature of the department is the method of conveying power from the driver on the engine shaft to the jack shaft, and secondary transmissions which are driven by the engine shown.

The distance between the main centres is thirty-eight feet. The fly wheel, planned and built by the company, is 22 feet in diameter, 25 inches face, and weighs 27,000 pounds. The hub, arms and a portion of the rim are of iron, while the surface of the rim is of wood and is grooved for ropes. This wheel was put on the shaft after the shaft was in place, and turned up, has been running five years, doing 500 h. p., and is in as good condition as when first started. The rope drive from this wheel to the jack shaft has proved most successful. The original rope is still doing service and without any delay to machinery, and to all appearances will run five years longer without renewal.

From a careful estimate of the comparative cost for belt and pulleys, versus rope and grooved wheels, this rope could, it is claimed, be renewed every eight months and still be inside of cost and maintenance of belt.

Where several prime movers are connected to one shaft, the quill or hollow shaft arrangement, shown in Fig. 2, with friction clutch connection to line shaft, has many advantages. The Dodge arrangement combines the use of Dodge split friction clutch, chain oiling journal boxes, adjustable floor stands and iron centre wood rim pulleys. The line shaft is thus relieved of heavy belt strains from power connections not in motion as well as the laboring or driving motive power, and has but the torsional or transmission strain to resist. The main driving pressure is thrown into an independent set of journals which support the quill, the pressure per square inch of bearing being greatly reduced from that which occurs in main connections which are direct to the shaft. For electrical service the "quill" is highly recommended by the company. With wood rim pulleys the journal pressure is said to be much less, owing to running slacker belts than when iron pulleys are used. A sample quill outfit is shown as a portion of the company's exhibit at F 27, Machinery Hall, World's Fair.

THE NEW CENTRAL STATION AT LYNN, MASS.

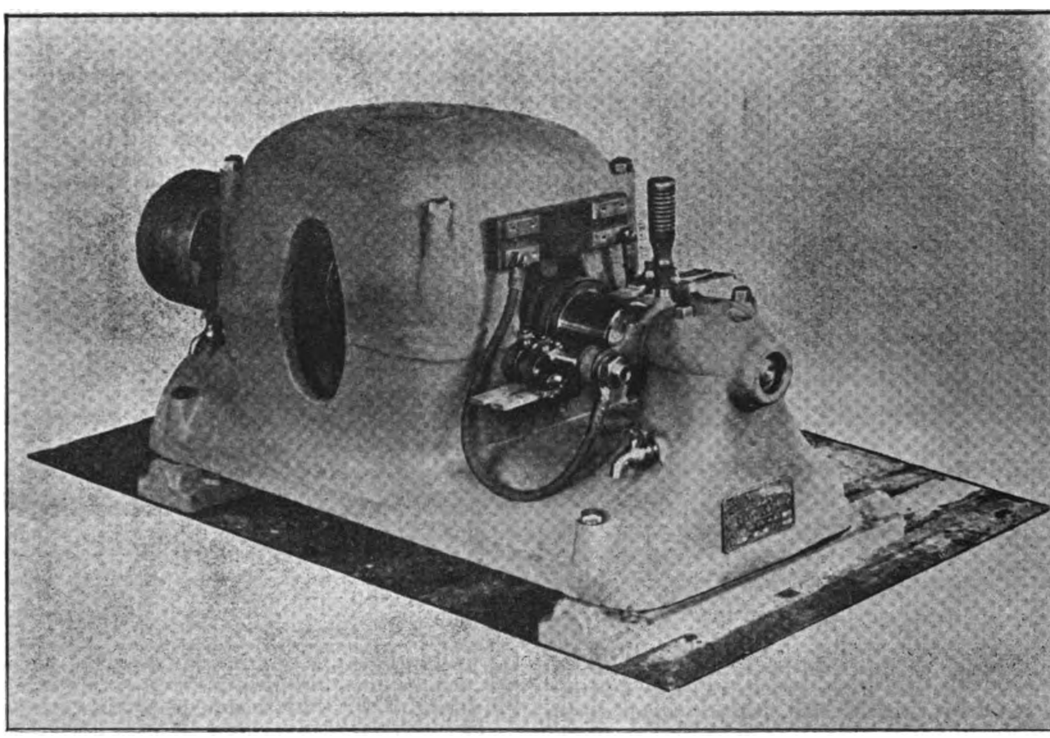
The new station for the Lynn Gas and Electric Co., will be built by The Berlin Iron Bridge Co., of East Berlin, Conn. The dynamo room is 58 feet in width by 157 feet in length, the whole space being served by a traveling crane. The boiler room will be 48 feet in width and the same length as the dynamo room. The roof of this building will be entirely of iron, constructed under the well-known patent of the Berlin Iron Bridge Co. The Berlin company's patent anti-condensation corrugated iron roofing is in great favor with electric light and power companies as it is fire-proof, and at the same time the manufacturers guarantee that there will be no drip or condensation on the underside of the corrugated iron.

THE SHAWHAN-THRESHER DYNAMO AND MOTOR.

Our readers will have noted the appearance in our advertising columns for several issues past of an illustration of the Shawhan-Thresher dynamo and motor, similar to the illustration appearing on this page. We believe that the electrical public will be interested in a description of the machine. It is needless to call attention to the compactness and evident simplicity of its construction. The machine is of the iron-clad type and is made of cast steel, cast in two parts, and of such a form as to afford complete protection to the armature and field coils, yet with a view to perfect ventilation of these parts.

The armature is of the drum type, with a special winding, which brings the coils of the highest potentials farthest apart. The field coils are wound separately, and are then slipped over the pole projections. The leakage of the machine is reduced to a minimum by placing the magnetic material so as to conform, as nearly as possible to the theoretical lines of the magnetic force.

The journal boxes of the machine are of strong and rigid construction, with flexible bearings, self oiling and universally supported. The object aimed at has been to secure the largest output, with the greatest durability of apparatus and the least amount of attendance.



Shawhan-Thresher Dynamo.

These machines are made from one-half h. p. up to any size desired, and the Shawhan-Thresher Co., of Dayton, Ohio, have unlimited facilities for building on short notice anything the intending purchaser may desire. Quite a number of machines have already been constructed and installed on order, and are giving excellent results.

ELECTRICITY ON THE ERIE CANAL.

The Westinghouse Co. has obtained permission to experiment with electric towage on the Rochester level at Pittsford, along the Erie Canal. There will be trolley connections running to a motor which drives the propeller shaft.

GRAY TELAUTOGRAPH IN PRACTICAL OPERATION.

The first Gray telautograph in practical use is operated between the Western Union supply house on the north side of Chicago, and the main office. The line is in use almost constantly and gives the best satisfaction. Dr. Gray has an interesting exhibit of his invention in Electricity Building.

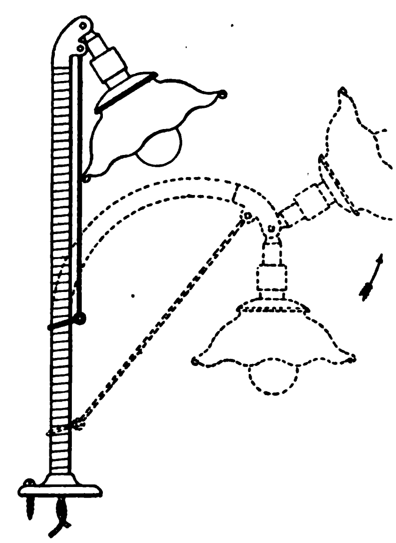
THE DAVENPORT ELECTRIC LAMP FIXTURE.

THE accompanying illustration shows an extremely novel device designed for supporting an electric lamp upon an office desk, or a reading table, and provides for instantly adjusting and holding the lamp in almost any required position. The full lines show the fixture in its normal position, and the dotted lines show two of the many positions to which it may be adjusted.

A stiff spiral coil of wire is mounted on a base, and the base is screwed to the table; the coil is provided at its upper end with a jointed head piece, which is slipped into the end of the coil and held by a set screw. The head piece is threaded to receive an ordinary electric lamp socket. The coil is sufficiently stiff to hold the lamp and remain perpendicular, and if it is bent to either side, it will, when released, spring back to its normal form. In order to control and utilize this tendency, a slender rod is pivotted by one of its ends to the head piece, and its other end carries a ring which loosely encircles the spiral coil.

If the lamp is pulled down so as to bend the coil, the ring will slide down, and when the lamp has reached the desired position it may be released, and the resiliency of the coil will draw up one side of the ring, causing it to bind, or lock against the coil, and hold the lamp as required.

The coil is held to the base by a tube extension, which passes part way into the coil, and serves as a pivot upon which the whole fixture may be revolved. This revolving movement is limited by a stop which engages the outward turned end of the coil and thus prevents the conducting wires, which pass through the centre of the coil, from becoming unnecessarily twisted. A spun brass cap covers the whole of the base piece, the coil passing through a hole in its centre, and being prevented from leaving the base by the outwardly turned end, which cannot pass through the hole in the cap.



DAVENPORT ELECTRIC LAMP FIXTURE.

The conducting wires from the lamp pass through the hollow head piece, through the spiral coil and the tubular entension of the base piece to the circuit.

Another form of head piece which is employed with this fixture dispenses with the joint proper, and carries the lamp at the end of a very short flexible spiral spring, the spring being provided with a device which limits its stretch. This forms a very efficient and inexpensive joint, the lamp being always pendant, and throwing its light downward.

The device has recently been patented by Mr. F. W. Davenport, of Providence, R. I.

CANADIAN NOTES.

WHITNEY ELECTRICAL INSTRUMENT CO.—The Canadian branch of the above company is busy filling orders for Canadian and European trade. They were awarded the gold medal at the Great Eastern Exhibition held at Sherbrooke, Can., this month, the merit of their voltmeters and ammeters being thus recognized in the Dominion not less than in "the States."

ST. LOUIS NOTES.

THE ADAMS-GENERAL ELECTRIC litigation has been resumed in St. Louis. Dr. Wellington Adams and his company claim to have the earliest patents controlling present methods of electric car construction, as already noted in these columns several times. There are already over 4,000 printed pages of evidence.

PHILADELPHIA NOTES.

QUEEN & COMPANY, INCORPORATED, recently secured an order for the testing outfit to be used by the Philadelphia Traction Company, in its new power house at 18th and Mt. Vernon streets. This is a very satisfactory testimonial for the Queen apparatus, as a similar contract was executed between the same parties last year.

MR. CHAS. E. HAGUE, late with the General Electric Company, has resigned to accept a position with F. E. Bailey & Co., Philadelphia, representatives of the Harrisburg Foundry and Machine Works.

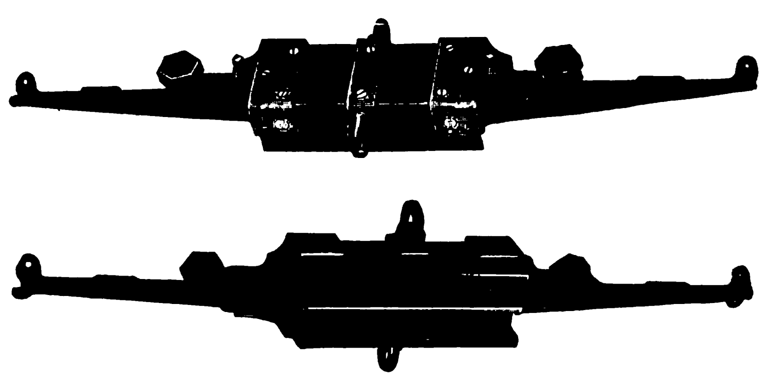
WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY report a number of nice orders for the new Hammond porcelain cleat which they have been introducing to the western trade. Its peculiar merit consists in the fact that it is only one piece of porcelain, and that it holds the wire away from the wall or ceiling like an insulating knob instead of clamping it against the surface. The price is also very reasonable.

NATIONAL ELECTRIC MANUFACTURING COMPANY.—The receiver's sale has been postponed until Nov. 1, when it is announced to take place at the Eau Claire factory at 10 a. m.

THE "NEW YORK" SECTIONAL INSULATOR.

THE accompanying illustrations show an entirely new form of sectional trolley wire insulator recently introduced by the New York Electrical Works, of 161 Washington street, New York city. As will be seen, the central ridge, upon which the trolley runs, divides the insulating block into two grooves. One-half of each groove is faced with copper connecting with the trolley wire at the corresponding end, so that the conducting surface of one begins where that of the other stops. The flange of the trolley thus moves smoothly from one to the other without a break and the supply of current to the motor and lights is uninterrupted.



"NEW YORK" SECTIONAL INSULATOR.

The insulator is simply and strongly made and is already doing good work on the lines of the Brooklyn City Railroad Company.

NEW YORK NOTES.

THE STIRLING BOILER CO., F. A. Scheffler, general sales agent, has recently closed the following sales: 100 h. p. boilers for Salem, Mass., through their agent, J. Bradford Sargent; 400 h. p. boilers, Algonquin Coal Co. and 250 h. p. boilers for Intz, Liboy & Co., Park Place, Pa., through their agent, Jas. Meily. Inquiries from various electric light and power companies, architects, etc., are coming in to a greater extent than they did in July and August. This shows that business is unquestionably improving throughout the country.

THE C. & C. ELECTRIC MOTOR CO. has dropped the word "Motor" from its title, so as to have its name in keeping with the larger scope of its product and work. It has recently made a change in the handling of its Philadelphia business, and has opened a nice store and office at 633 Arch street, with Mr. Young in charge. The C. & C. company has put in a number of fine combination power and lighting plants this year.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
·Electrical Engineer.

Vol. XVI. OCTOBER 4, 1893. No. 283.

THE DEVELOPMENT OF ELECTRIC MACHINE TOOLS.

BY

S S Wheeler.

I.

SINCE the appearance of my recent article on the above topic in THE ELECTRICAL ENGINEER,[1] I have been gratified to note the interest shown in the subject, and the approval generally expressed of the views that I then advanced. They seemed to me then, as they still do, a little ahead of the times, for there can be no question that some mechanical engineers and electricians are far from convinced that it is desirable to modify the form of the tool so as to admit of a blending of the two elements in one. Many able engineers think it is well enough to bring the power cheaply and conveniently to the tool, but they then prefer to keep separate the motor and the driven mechanism. In traction, there are some authorities who are wedded to the old practice of having the motive power in a freely detachable engine, while, as a matter of fact, a marked tendency in all the successful traction work by electricity has been toward having the motive mechanism in each car, and I do not overstate the case when I say that almost all distribution of power in the future promises to be done on the same principle.

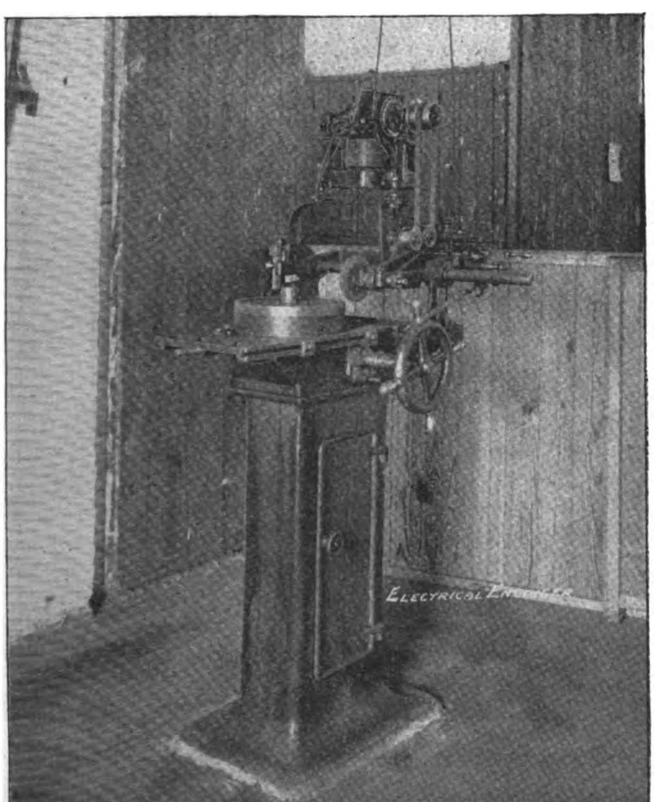


FIG. 1.—ELECTRIC SURFACE GRINDING MACHINE.

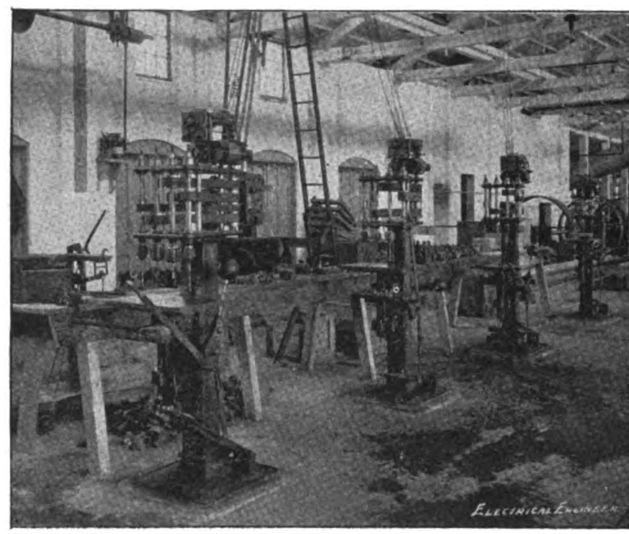


FIG. 2.—BATTERY OF FOUR GANG DRILL PRESSES.

Be this as it may, it has seemed to my associates and myself that we realized the highest efficiency, economy and flexibility in embodying our power within the tool, so that each tool might, itself, be fairly called an electric motor. My previous article described some of our successful experiments in this direction, and I am now glad to avail myself of these columns to illustrate further some of the ways in which we have carried out our ideas. It will, perhaps, be remembered that early this year our motor shops were transferred to Ampére, N. J., and it is there that the first tools already described, and those now under consideration, have been installed. If we were not satisfied with them, we knew that nobody else would be, and we were perfectly satisfied to find out the difficulties ourselves and solve the new problems that inevitably spring up rather than leave our customers to doubt our judgment because we had been led by enthusiasm to put some imperfect novelty on the market. Unfortunately, that happens too often in electrical development. Before proceeding to the descriptions, I pause simply to note the readiness with which these ideas have been applied. For example, as one result of the accident to the propeller shaft of the "Umbria," it has been influentially urged that, as every steamer has an electrical plant, it ought to carry electrical machine tools, ready at a moment's notice, and able to go into a very small space. It is said that, with a portable electric drill, for instance, the holes in the "Umbria's" shaft could have been bored in one-fifth the time that was actually consumed, and with infinitely less trouble. Anyhow, it is obvious that a self-contained electrical machine tool is much handier than would be two sets of

1. E. E., Vol. XV. No. 258, p. 851.

mechanism to do the same work under the same circumstances.

II.

I have already said that these tools were all built for the new works of the Crocker-Wheeler Electric Company at Ampére, East Orange, N. J., where the electrical method of distribution and driving has been broadly introduced.

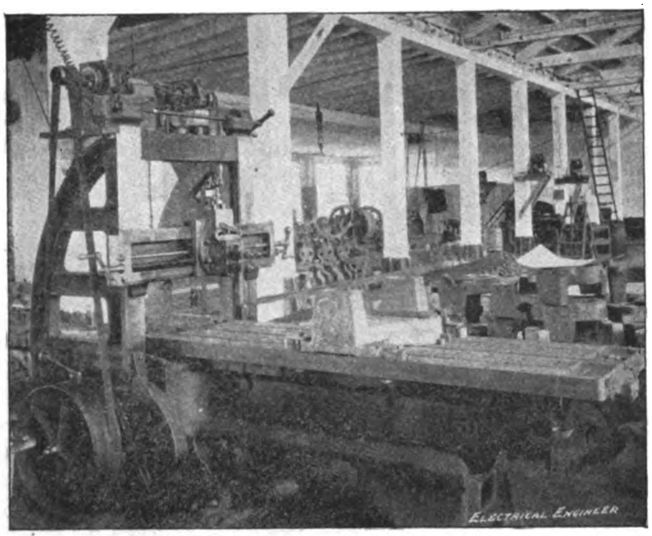


FIG. 3.—PLANER DRIVEN BY TWO SMALL MOTORS.

As the main line shafting, about one thousand feet in all, previously in use in these works, was removed as a preliminary to their occupancy of the property, it became necessary when moving there to make provision for the electric driving of the ordinary belt driven tools from the old shop, or at least of such of them as could be equipped with advantage. The methods employed on some of these tools are shown in the accompanying illustrations.

A few, chiefly lathes, were belted in groups of five to single lengths of shafting, driven by motors bracketed to the columns of the building. In these cases the shafts were placed end to end in line, so that they could be coupled in pairs, threes, etc., in case it was found that larger divisions were more economical in driving. So far this has not been found desirable, on account of the greater flexibility of the present arrangement.

The greatest difficulty in the introduction of motors on tools is due to the wide range of speeds met with in different tools, which is made still worse by the fact that almost without exception all industrial devices have been designed, improved, etc., solely with reference to belting, its conditions and limitations. The writer is strongly impressed with this, from experience so far had, in specially designing a few electric tools. But this is entirely overcome, and in each case several important advantages are secured, by starting at the bottom in design, and making a machine with reference to the high quiet speed of the motor spindle. That is to say, in most cases more difficulties have been met and provided for, in designing and developing a given belted machine, say a profiler, in making a frame and bearings to stand the strain of the belt, in carrying the belt to the *traveling* tool, and in gearing up for sufficient tool speed, than would be the case in building one for a motor, where the cutter holder can carry the motor and there are no strains or jerks. The speed-increasing gearing would simply have to be reversed, permitting the motor to run faster than the tool, instead of slower as in the case of the belt. And yet if we are compelled to start with a profiler already built, it is not easy to get the full advantages of simplicity in driving by motor to which we are entitled, just because the speed ratios of the gearing are opposite to what is now required, and everything is arranged for belts. In the case of other tools other features of a similar nature require changing. In a later article the writer hopes to describe a few other machines, re-arranged electrically.

III.

Fig. 1, is from a photograph of a surface grinding machine, used in sharpening armature and other dies. This tool was operated by two independent belts from an overhead countershaft, but when, by the removal, electric power became available in all parts of the shop, the countershaft was done away with, and a ½ h. p. constant speed motor was mounted directly on the sliding carriage which supported the grinding wheel, and whose cross-wise sliding motion carries the wheel to all parts of the surface to be ground. A light belt was run from the grinding wheel under two idlers to the motor pulley, and as the motor was light enough to move with the carriage, it became possible to avoid the use of a pulley with long face equal to the total motion of carriage, across which the belt traveled when the carriage moved, which was formerly required on the countershaft. The motor is supported by four bolts with check nuts, by means of which it can be raised or lowered about half an inch, to keep the belt at proper tension. The power required by this tool on the 1 0-volt circuit never exceeds two amperes, and is supplied to it by a twin conductor, which may be seen in the view crossing the window in the background.

Fig. 2, is a view of a battery of four gang drill presses, which were formerly driven by belts from overhead countershafts, the belts coming directly down, then turning in a horizontal direction by the means of two idler pulleys attached to the top of the press, and thence passing around a driving pulley on a vertical shaft at the back of the press, which shaft carries four smaller pulleys operating the four spindles by means of four short belts in the usual way. The driving pulley on the upper end of this vertical shaft

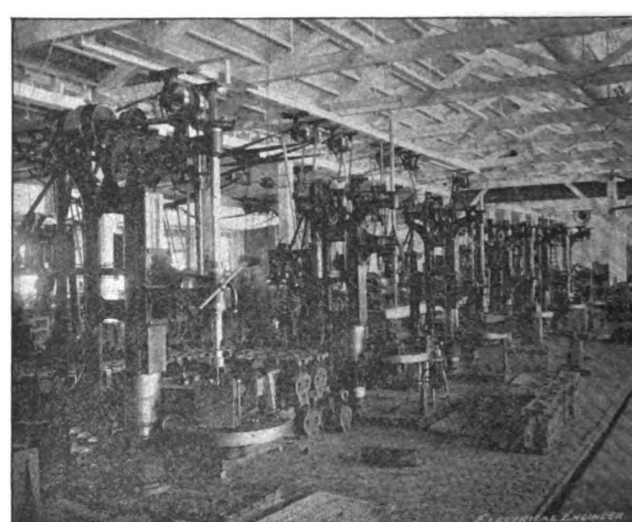


FIG. 4.—ROW OF LARGE DRILL PRESSES.

was removed and a motor armature slipped on in its place. The field magnets and regulator for the motor were then fastened to the drill press frame (as shown in the view), completing the machine. By this means the driving power was applied directly to the back spindle of each drill press, saving at least one-half of the power formerly required. In these machines the necessary changes of speed are effected by a switch, which throws the armature either on to the 110 or 220 volt circuit accordingly as a slow or fast

speed is required, the fields remaining on the 110-volt circuit until the switch is turned entirely off when the fields are disconnected. By this arrangement the simplest windings of motor without divisions of the field coils or series

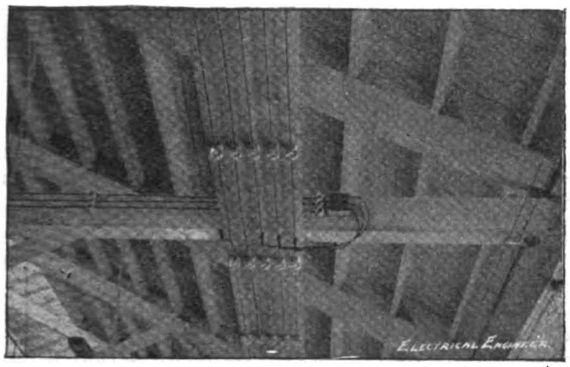


Fig. 5.—Main Circuits and Branches.

multiple switches, are made to give the required changes of speed running in either case with perfect efficiency.

Fig. 3 shows a common planer, built to be driven by one straight and one cross belt from a countershaft, but which is now operated by two short belts, neither of them crossed, from two motors placed on a shelf bolted to the top of the tool frame of the planer. This arrangement gives several new possibilities in the operation of a planer. The relative speeds of the forward and back motion of the platen can be regulated by simply turning the hand regulators of the respective motors and the platen can be sent the whole length of the bed in either direction without being returned, by starting one motor without the other. The construction, however, was simply a make-shift to get the planer into operation quickly by the use of standard

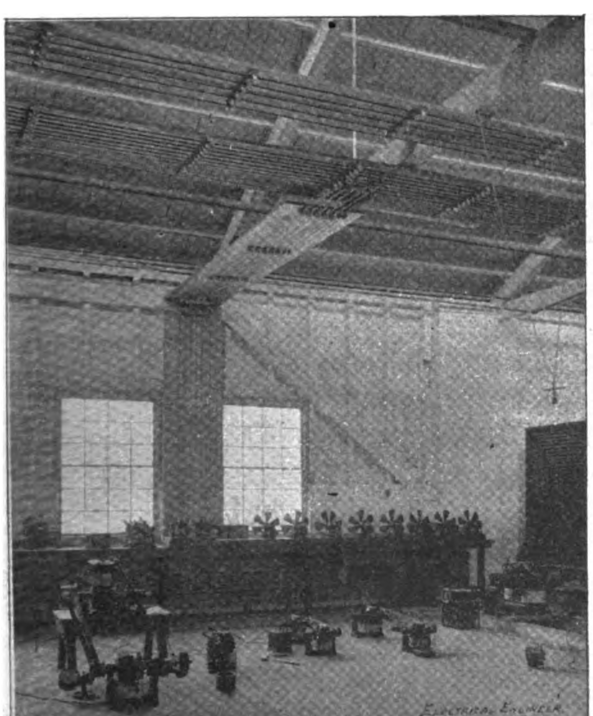


Fig. 6.—The Power and Lighting Circuits for Testing Room Work.

motors, and will probably be changed at convenience by the substitution of a single motor with a long shaft and two pulleys, for the two belts. Since the momentum of the platen requires either a heavy armature or a fly-wheel to stop and reverse it, the effect at present is to slow the motors up momentarily and produce sparking.

Fig. 4 was intended to show the method of operation of a row of large drill presses by individual motors, but owing to the unfortunate position from which the view had to be taken, it is a general view of a corner of the shop. The countershafts and horizontal belts in the view attached to the trusses have nothing to do with the presses, but are those mentioned in the first part of this article in connection with lathes. The drills were all formerly operated by belts from the ceiling to the countershafts attached to the base plates of the presses, from which the power was transmitted by short belts to other shafts at the top of the presses and then by bevel gears to the drill spindles. The motors now used are supported on heavy yellow pine brackets clamped to the pillars of the presses about halfway up, and the power is carried to the countershafts by short belts. The wires from these motors cannot be seen distinctly in the view, but run straight up to the roof trusses. On the side of each alternate truss may be seen

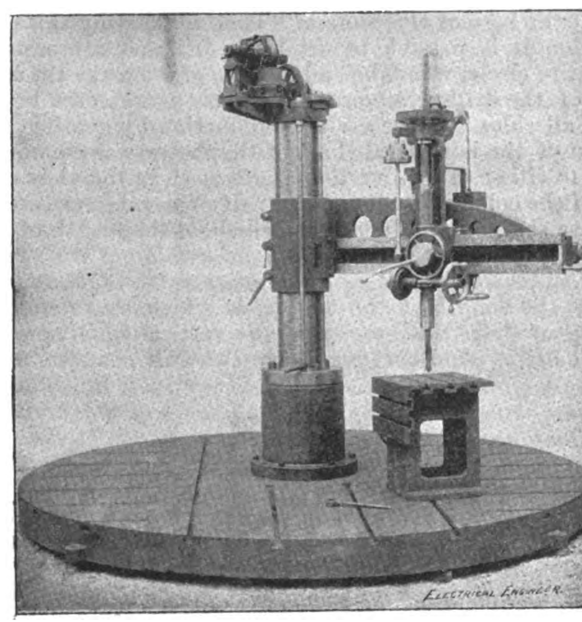


Fig. 7.—Drill Run by Motor.

the three wires to which they connect and which are the main branches from the round copper rods running the length of the shop.

The method of connecting these main branches to the main bars which run the entire length of the shop, is shown in Fig. 5, the connections from the main bars to the branch cut-outs being made by flexible cables attached to brass clamps, similar to a lathe dog cut open on one side. The tails of these clamps or dogs, drop the cables down about three inches below the main bars, giving a clear space for crossing the other bars. At the same time the clamps furnish a ready means of making firm connection to the bars after the latter are in position. These main shafts are half-inch round copper rods in straight twenty foot lengths, joined with cylindrical or sleeve couplings soldered, the rods being attached to the under side of a line of wide planking by the largest size of porcelain hook insulators. The three rods on the right hand in the view, serve to supply either 110 or 220 volts, at all points in the shop, thus furnishing a means of running at a fast or slow speed without regulator boxes, except for small intermediate gradations. The two lines on the left are heavy insulated wires for lighting.

In addition to this set of circuits, which extends throughout all parts of the main and subsidiary buildings, another set of about as many conductors runs from the engine

room to the testing room, shown in Fig. 6, in which the nearer set of conductors are the power and lighting circuits as before; and the farther set are the leads and field regulator wires from the dynamo room to the testing room. These test bars are branched off in four directions and brought down the four sides of the room, and are again branched and carried lengthwise under every bench, so that all the different voltages and special variable circuits are available at all points in this room. The conductors at all points of branching are carried in the same relative positions and the cross-overs are made at different levels about 6 inches apart; each rod being carried to a point directly under the one to which it is to be connected, and soldered into the lower end of a rectangular brass piece, the upper end of which surrounds the corresponding rod.

IV.

Fig. 7 is a large drill, built especially to be operated by a motor. The motor is mounted on a cast-iron bracket, forming the cap of the drill column, thus taking the driving power out of the way of the swing of the drill arm; the countershaft having formerly been located on one side at the base of the column. The fact that by this construction it is possible to swing the drill and arm around the entire circle, was taken advantage of, to make the bedplate of the drill-press circular, so that work could be set up on all sides. After a single reduction by gearing, the motion of the horizontal shaft of the motor was communicated to either of two vertical shafts seen in the view outside of the column by means of a pair of bevel gears. One of these shafts carries a gear which slides the length of the shaft, following the motion of the swinging arm when raised and lowered, and which gear drives a shaft extending out the length of the arm, upon which shaft another bevel gear slides and gears with the vertical spindle carrying the drill. Another gear near the drill connects with the horizontal shaft on the arm to drive the feed mechanism. The second vertical shaft close to the central column is used to raise and lower the entire swinging arm with the drill and feed mechanism, a matter requiring considerable power. When this arm is to be raised or lowered, the motor is thrown into gear with this shaft, by swinging the intermediate gear away from the other shaft and into gear with it, in the same manner as the lever and back gears on a lathe are operated. If the arm is to be lowered, the direction of rotation of the motor is reversed by the reversing regulator. In the final tests of this tool at the shop, a man sat on the end of the swinging arm and rode up and down with the drill. The motor used is a 1 h. p. Crocker-Wheeler standard machine.

V.

These examples of some of our latest work will enable the readers of this article to form a conception of the lines upon which we are working and which we believe to be fundamentally sound. The argument is that it is better to take the tool to the work than bring the work to the tool; that it is better to have the tool self-contained so that by attaching to the copper mains it is at once ready to run at maximum efficiency. In our own shops this has certainly proved true in the manufacture of machinery that does not run into excessive sizes, but it must be even more true when we consider how bulky and heavy much of the modern machine work is. Units that we all thought gigantic have come to be small, no matter what the industry is; and in order to get the various parts treated, shifted to and fro, and assembled, shops have spread out acres wide and miles long; whereas, the greater availability of these electrical machine tools makes for the highest concentration of effort and the smallest area of valuable real estate, combined with the utmost utilization of every watt that the central power plant sends out.

WORLD'S FAIR DEPARTMENT.

JUDGING WORLD'S FAIR EXHIBITS.—II.

Alternate Transformers.—Sub-committee 3, having in charge the testing of the transformers, of which Prof. Harris J. Ryan is chairman, have drawn up the following general method, from which the scope of the test will be readily understood.

The points to be judged are:

Mechanical construction.
Character of insulation.
Effectiveness in operation of useful auxiliary fittings and attachments; and
Efficiency in performance of duty as determined by these measurements:
Watts, dissipated when the primary is subjected to the normal working pressure and the secondary is on open circuit; measurement to be made with a standard wattmeter.
Resistance of primary and secondary; measurement to be made by fall of potential.
Regulation to be determined by simultaneous primary and secondary pressure readings at no load and at a full load.
Consideration will be made of the exhibitors' claims in connection with the results of examination.

In these tests special care has been taken to insure the accuracy of the instruments employed in taking the readings. For that purpose, the Weston wattmeter is employed, calibrated in the following manner: The wattmeter of 300 watts capacity has its field or fixed coil F C, Fig. 1, placed in series, with an electro-dynamometer D and also with a coil C, having a high self-induction with a power factor of .25, that is, in which the apparent energy consumed is four times as great as the actual.

The moving coil M C of the Weston wattmeter, is placed in long shunt to the entire series. The terminals lead to a

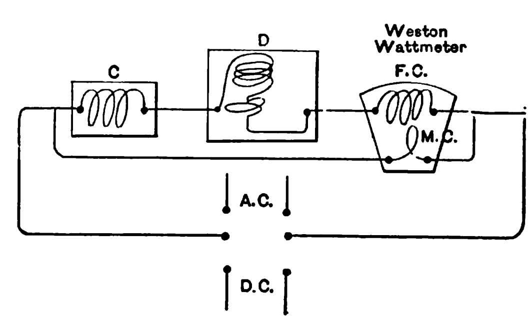


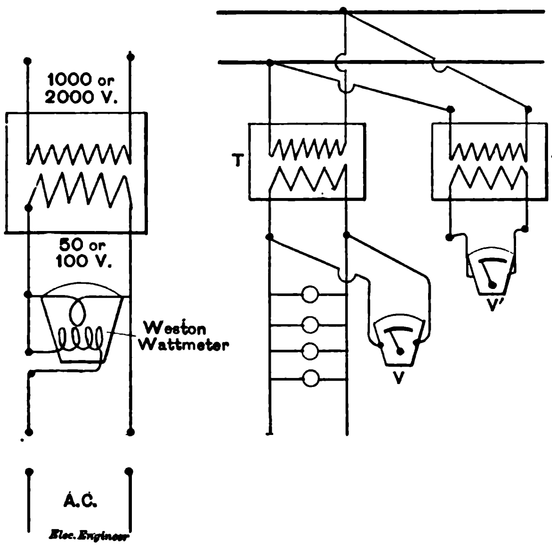
Fig. 1.

three-way switch and the wattmeter is tested by having alternating current passed through it from the terminals marked A C, and by direct current from the terminals D C.

As indicated above, the tests will embrace the core losses, for which purpose the transformer will be arranged as shown in Fig. 2. Current from an auxiliary transformer connected at A C, will be brought in at 50 or 100 volts as the case may be, and led into the secondary of the

transformer to be tested, the primary being left on open circuit.

In the test for regulation, the method employed is that shown in Fig. 3. Here the transformer to be tested is shown at T. A voltmeter V being joined to the lamp circuit, close to the transformer's secondary. In order to avoid determining and taking into account the additional losses in the line, etc., which would take place at various loads, a sec-



FIGS. 2 AND 3.

ond transformer T′ is connected to the same points on the line as the transformer T, with a voltmeter V′ connected to the secondary, and not loaded. With no load on transformer T, the indications of both voltmeters will correspond exactly, but as lamps are thrown into the circuit of transformer T, its potential will drop, and to a slight extent, also, that of the voltmeter V′. The indication of voltmeter V represents the entire drop in potential of both line and transformer, while that of V′ represents the drop in the line only. By reading the *difference* in the indications between the two voltmeters, therefore, the true fall of potential due to the transformer load, pure and simple, is determined. Account will also be taken of the drift or pumping of the dynamo by taking a series of observation at definite intervals, and at different loads, and making allowances in the indications obtained.

The resistance of the transformers will be measured by the fall of potential method with the aid of a Weston millivoltmeter.

The companies whose transformers are entered for this test, are the Westinghouse Electric and Manufacturing Company; General Electric Company; Fort Wayne Electric Company; Brush Electric Company; Electric Forging Company; Stanley Electric Manufacturing Company; Electric Construction Company; and Wagner Electric and Manufacturing Company.

TESTS OF INSULATED WIRES AT THE WORLD'S FAIR.

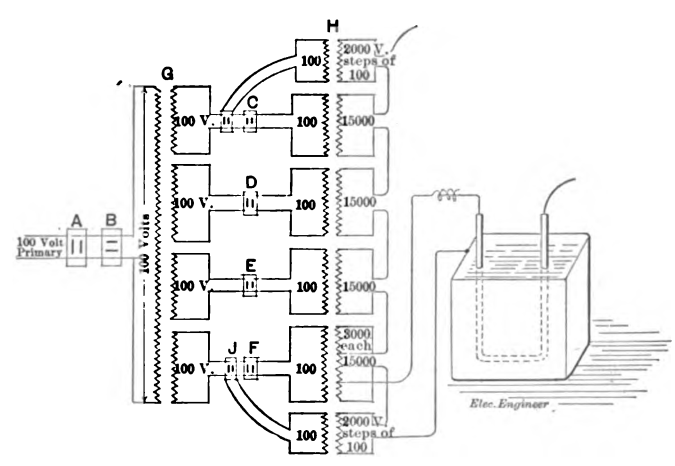
THE sub-committee having in charge the testing of insulated wires, consisting of Profs. Owens, O'Dea and Jackson, is progressing rapidly with its work. The wires entered for the test are the Okonite, Kerite, Simplex, Grimshaw, and those of the India Rubber Comb Company, Washburn & Moen Manufacturing Company, and the Western Electric Company.

The wires will be subjected to the usual tests for resistance, insulation and electrostatic capacity. In addition to this, however, they will undergo a breakdown test to determine at what potential the insulating material suffers puncture from the applied E. M. F.

The method employed for this test is almost identical with that which has for some time past been in use at the works of the Westinghouse Electric and Manufacturing Company. Indeed the apparatus employed by the judges has been placed at their disposal by the Westinghouse Company for this purpose. The accompanying diagram shows clearly the manner in which the tests are made.

The current required to break down the wires is obtained primarily from a 100 volt alternating circuit. This is first passed through a safety switch A and then through a special double fuse block B. In arrangements of this nature it is, of course, necessary to prevent the high tension from reaching ground or the primary and hence the insulation of the high tension and other transformers must be carried out in the best possible manner. In order to prevent the high tension from breaking through insulation and getting back into the 100-volt primary circuit a special "insulating converter" G is employed. This converter as will be seen consists of a primary connected to the 100-volt circuit with four secondary coils each giving 100-volt tension, all included within the same converter box. The terminals of these 100-volt coils of the converter G pass through switches C, D, E, F and into the primaries of four high tension coils, H, each capable of raising the potential to 15,000 volts. In addition to this there are two additional high tension transformers of 2,000 volts each. Three of the 15,000 volt converters are not regulable but one of them, as shown, can be thrown on in steps of 3,000 volts each, while the 2,000-volt converters are graduated in steps of 100 volts. The readings are taken by means of a Thomson electrostatic balance reading up to 100,000 volts.

The wires, of a uniform length of six feet, have three feet of their length inserted in a tank full of water, the insulation, of course, extending above the surface. One terminal of the high potential converter sets is connected to the tank, as shown, and the other terminal to one end of the wire to be tested, the other end of the latter being left free. Beginning with the lowest potential the pressure is left on for 10 seconds. If the wire stands it, the next higher pressure is put on and so on, each potential being applied for 10 seconds. The current is thrown on with the



BREAKDOWN TEST APPARATUS FOR INSULATION.

safety switch at A; when the insulation breaks down the fuse at B blows. This arrangement has proved very satisfactory and very rapid work can be done with it.

In addition to the breakdown tests it has been suggested by Prof. Barrett that it would be highly desirable to test wires after having been subject to the action of acids and ammonia as well as plaster. Although not definitely determined upon, it is probable that, with the aid of Prof. Barrett, a series of such tests will be carried out in the near future.

LIST OF ELECTRICAL AWARDS AT THE WORLD'S FAIR.

THE following companies, firms and individuals have been awarded prizes for the excellence of their apparatus on exhibition in the Department of Electricity. One or two classes, such as insulated wires and incandescent lamps are not included, the awards not being given out.

UNITED STATES.

Albert & J. M. Anderson, Boston, Mass.; 1. Trolleys; 2. Railway insulators.

American Battery Co., Chicago, Ill.; Storage batteries.

Brush Electric Co., Cleveland, Ohio; 1. Direct current dynamos for series arc lighting; 2. Direct current dynamos for series arc lighting coupled to engines, 125–2,000 c. p. lamps; 3. Alternating current dynamos constant potential, 36–150 k. w.; 4. Arc circuit switchboard; 5. Direct current dynamos constant potential, 20–100 k. w.; 6. Arc lamps all types.

Bryant Electric Co., Bridgeport, Conn.; Snap switches.

W. R. Brixey, New York; Underground, aerial and submarine telegraph and telephone cables.

J. H. Bunnell & Co., New York; 1. Standard dry batteries; 2. Telegraphic apparatus.

C. & C. Electric Motor Co., New York; 1. Direct current motors, constant potential, 3–50 h. p.; 2. Electric motor fan and blower combination.

Cutter Mfg. Co., Phila., Pa.; Push switches for electric lights.

Commercial Cable Co., New York; 1. Ocean telegraphic apparatus operating through Muirhead's artificial resistances; 2. Cuttriss improved cable telegraph apparatus.

Crane Electric Co., Chicago, Ill.; Electric passenger elevator, complete.

Carpenter Enamel Rheostat Co., Bridgeport, Conn.; Rheostats.

Copenhagen Fire Alarm Co., Chicago; Automatic fire alarm.

Geo. Cutter, Chicago, Ill.; Lamp supporting pulley.

Electrical Forging Co., Boston, Mass.; Electric heating and welding apparatus.

Electric Heat Alarm Co., Boston, Mass.; Thermostat for automatic fire, hot journal and hot grain alarms.

Eectrical Conduit Co., New York; Underground conduit for electrical wires.

Electric Launch and Navigation Co., New York; Electric launches.

Eddy Electric Mfg. Co., Windsor, Conn.; Direct current motors, constant potential.

Excelsior Electric Co., New York; 1. Arc lamps, series circuits; 2. Direct current dynamos for series arc lighting.

Elektron Mfg. Co., Springfield, Mass.; 1. Direct current motors, constant potential multipolar, slow speed; 2. Automatic motor starter.

Electric Selector and Signal Co., New York; Electrical system for locking and unlocking.

Edison Mfg. Co., New York; Edison-Lalande primary battery.

Eureka Tempered Copper Co., North East, Pa.; Tempered copper for use in electrical construction.

Fort Wayne Electric Co., Fort Wayne, Ind.; 1. Direct current "Wood" dynamo for series arc lighting; 2. Alternating current "Wood" dynamo constant potential compound wound, 150 k. w.; 3. Arc lamps for constant current.

I. P Frink, New York; Screen reflectors for incandescent lamps.

General Electric Co., New York; 1. Electric locomotive for factory and switch service; 2. Electric elevated railway system; 3. Long distance power transmission plant in operation, triphase; 4. Arc lamps for direct current series circuits; 5. Search lights and focusing lamps; 6. Transformers, 260–125,000 watts; 7. Engine-dynamos; 8. Automatic overload switch; 9. Electrically illuminated fountains; 10. Thomson eccentric coil ammeters and voltmeters for alternating currents; 11. Pumping machinery driven by electric motor; 12. Electrically driven rock-working machinery; 13. Mine locomotive; 14. Haskins' astatic ammeter; 15. Arc lamps for constant potential circuits, direct and alternating (Knowles); 16. Jaw switches, fuses, sockets and branch blocks; 17. Direct current dynamos for series arc lighting; 18. Alternating current dynamos constant potential 30–300 k. w.; 19. System of street railway service; 20. Direct current dynamos constant potential (direct connected excepted) and direct current shunt wound motors constant potential; 21. Edison feeder system for distribution of electricity; 22. Slate switchboard for arc light circuits; 23. Ventilating set, portable, Government standard; 24. Historical apparatus; 25. Edison three-wire system for distribution of electrical energy; 26. Exhibit of incandescent lamps all styles ½ to 250 c. p.; 27. Underground system complete in all details; 28. Hoisting apparatus driven by electric motors; 29. Integrating wattmeter.

Elisha Gray; Telautograph.

The E. S. Greeley & Co., New York; 1. Testing instruments; 2. Exeter dry battery; 3. Telegraph apparatus.

Gamewell Fire Alarm Telegraph Co., New York; Automatic fire alarm telegraph system.

General Incandescent Arc Lamp Co., New York; Arc Lamps for constant potential circuits.

Hart & Hegeman Mfg. Co., Hartford, Conn.; Snap switches.

Helios Electric Co.; Arc lamp for alternating current.

The Hanson Battery Co., Washington, D. C.; Primary batteries.

Interior Conduit & Insulation Co., New York; 1. System of interior insulating conduits; 2. Snap switches.

Jenney Electric Motor Co., Indianapolis, Ind.; Direct current dynamos and motors constant potential.

H. W. Johns Mfg. Co., New York; Vulcabeston and molded mica insulating material worked into all kinds of insulations.

LeClanché Battery Co., New York; LeClanché batteries, especially the "Vole" and "Cylinder" cells.

Mather Electric Co., Manchester, Conn.; Direct current dynamo, constant potential, 500 volts.

McIntosh Battery and Optical Co., Chicago, Ill.; Electro-medical, dental and surgical apparatus.

National Carbon Co., Cleveland, Ohio; Carbons for arc lamps.

Nutting Electric Mfg. Co., Chicago; Nutting arc lamp.

Otis Bros., New York; 1. Electric pump; 2. Electric motor and controlling devices for elevator and hoisting service.

H. T. Paiste, Philadelphia, Pa.; Snap switches.

Police and Signal Co., Chicago; System of police patrol telegraph.

Phœnix Glass Co., Chicago, Ill.; Electric and gas globes and shades, cut, etched and colored.

Queen & Co., Philadelphia, Pa.; 1. Electrometer (Ryan); 2. Galvanometers; 3. Testing sets and resistances; 4. Portable medical induction apparatus for physicians' use; 5. Commercial ammeters and voltmeters.

J. A. Roebling's Sons Co., Trenton, N. J.; Bare copper and trolley wire.

F. A. Ringler Company, New York; Half-tone photo-electrotype, steel faced.

Standard Electric Co., Chicago; 1. Arc lamps for direct current series circuits; 2. Direct current dynamos for series arc lighting.

Stevenson Harrison Electric Co., St. Louis, Mo.; Automatic electric time stamp.

Sperry Electric Railway Co., Cleveland, Ohio; Electric railway system.

Short Electric Railway Co., Cleveland, Ohio; Short electric railway system.

Self-Winding Clock Co., New York; Special application of an iron-clad solenoid magnet.

Thomson Electric Welding Co., Boston, Mass.; Apparatus for electric welding and forging.

Union Electric Works, Chicago, Ill.; Primary battery.

J. C. Vetter & Co., New York; 1. Incandescent current adapter; 2. Dry LeClanché battery.

Western Electric Co., Chicago; 1. Columbian street lamp post; 2. Telegraph apparatus; 3. Telephone cables, Paterson; 4. Annunciators and signaling apparatus; 5. Multiple switchboard for telephone service; 6. Direct current dynamos for series arc lighting; 7. Application of electric lights for the production of scenic effects in theatres and for the decoration of rooms, etc.; 8. Arc lamps, various styles for series circuits; 9. Arc lamps for constant potential circuits; 10. Direct current dynamos and motors of constant potential.

Waite & Bartlett Manufacturing Co., New York; 1. Holtz induction machines in air tight case with a 40-inch revolving plates; 2. Special faradic apparatus for varying the tension and strength of current (Engleman's apparatus).

Washington Carbon Co., Pittsburgh, Pa.; Carbons for arc lamps, batteries and dynamos and motor brushes.

Wm. Wallace, Ansonia, Conn.; Historical electric light exhibit.

Walworth Mfg. Co.; Poles for trolley and arc lamps.

S. S. White Dental Mfg. Co., Philadelphia, Pa.; Acid gravity batteries "Partz."

Westinghouse Electric & Mfg. Co.; Pittsburgh, Pa.; 1. Engine-dynamos; 2. Transformers, 250–12,500 k. w.; 3. Direct current dynamos and motors, constant potential, bi-polar and multipolar (except direct connected dynamos); 4. Alternating current dynamos constant potential 750 k. w.; 5. Electric street railway system; 6. Alternating current dynamos for series arc lighting; 7. Long-distance power transmission, plant in operation; 8. Two-phase alternating current motors (Tesla); 9. Incandescent system of street lighting; 10. Switches; 11. Complete switchboard for controlling 17 dynamos and 40 circuits; 12. Lightning arresters.

Weston Electrical Instrument Co., Newark, N. J.; 1. Alternating current instrument including wattmeters; 2. Standard resistances and bridges; 3. Electrical measuring instruments for physicians' use; 4. Switchboard instruments; 5. Direct current ammeters and voltmeters, standard and portable.

Western Union Telegraph Co., New York; Instruments used in quadruplex telegraph, latest design.

Zucker & Leavett Chemical Co., New York; Collection of chemicals and appliances.

GERMANY.

Prof. Aron, Berlin; Electric meters.

J. Berliner, Hanover; Universal transmitter, long distance.

Geo. Carette & Co., Nuremberg; Optical, physical and mechanical instruments and toys.

Dr. Edelmann, Munich; Electro-medical apparatus.

Felton & Guilleaume, Mühlhausen-on-Rhine; 1. Electric cables with special armor; 2. Electric cables.

Gasmotorenfabrik Deutz, Cologne, Germany; Dynamo direct connected to gas engine.

Gehmelzen, Nuremberg; Carbons for arc lights.

Hartmann & Braun, Frankfort; 1. Differential arc lamps; 2. Galvanometers; 3. Electrical measuring instruments including instruments of precision; 4. Photometer, large universal; 5. Apparatus for testing iron and steel with respect to magnetic permeability; 6. Reading telescopes, mirrors and scales; 7. Portable measuring apparatus used in laying cables.

W. A. Hirshman, Berlin; Electro-medical apparatus.

Imperial German Postal Telegraph Dept., Berlin; 1. Maps and drawings showing system of Government telegraph lines using armored underground cables; 2. Telegraphic apparatus of the German telegraph service; 3. Historical telegraphic apparatus.

Kerting & Matthiasen, Leipzig; Arc lamps for constant potential circuits.

Charles Pollak, Frankfort-on-the-Main, Germany; Storage batteries.

F. Schomburg & Sons, Berlin; 1. Insulators and insulating material; 2 Dry batteries.

Schuckert & Co., Nuremberg; 1. Search lights with parabolic glass mirrors; 2. Annunciators for vessels; 3. Arc lamps for constant potential circuits.

Siemens & Halske, Berlin; 1. Arc lamps for constant potential circuits; 2. Direct current dynamos, constant potential 750 k. w.; 3. Historical apparatus.

Schmidt & Haench, Berlin; Lummer-Brodhun photometer with accessories.

I. Zacharias, Berlin; Dry batteries.

GREAT BRITAIN.

British Government Postal Telegraph Dept.; 1. Modern telegraph apparatus in operation; 2. Historical telegraph apparatus.

Corporation of Birmingham; Original Woolwich dynamo.

Epstein Accumulator Co., London, Eng.; Storage batteries.

General Electric Co., Ltd., London; H. I. switches and other incandescent house fittings.

James White, Glasgow; Electro magnetic balances (Kelvin).

TURKEY.

Imperial Ottoman Government; Telegraphic apparatus.

AUSTRIA.

F. Hardtmuth & Co., Vienna; Carbons for arc lamps, etc.

RUSSIA.

Imperial Russian State Paper Manufactory, St. Petersburg; Collections of electrotypes.

Imperial Artillery Arsenal, St. Petersburg; Electrical registering attachment for testing machine (Prince Gagarian).

ITALY.

Prof. G. Ferraris, Turin; Historical alternating current motors.

JAPAN.

Imperial University, Tokio; 1. Seismographs and accessory apparatus; 2. Model of an earthquake.

Department of Engineering, Imperial University, Tokio; Automatic electric current recorder.

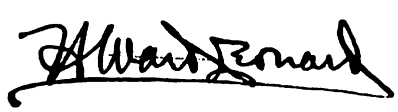
BRAZIL.

Directoria Geral des Telegraphos, Rio de Janeiro; Telegraphic apparatus.

ELECTRIC RAILWAY DEPARTMENT.

THE CONTROL OF ELECTRIC CARS.

BY



I QUITE agree with THE ELECTRICAL ENGINEER that it is unfair to charge to the account of the motorman, the responsibility of the numerous accidents, which are daily being chronicled by the newspapers. The cause of the accident is directly traceable to the lack of proper methods and devices for controlling the car. Being the inventor of a method of control for electric motors, which after two years of thorough test upon electric elevators and traveling cranes, has demonstrated its perfect adaptability for controlling the movement of bodies of large weight which must be accelerated and retarded smoothly, rapidly and by simple means, I naturally think that there is no excuse for the entirely inadequate control of electric street cars. Any street railway company desiring to use my method for its present street cars is at liberty to do so without royalty or other expense due to its being patented. Unfortunately those who might best utilize such an improvement desire to secure exclusive rights before applying it, which, if the invention be a good one, means infringement, litigation and probably little or no return to the inventor. When the situation as regards new inventions is appreciated by the large street railway companies, they will probably encourage development and application of improvements which will be of the greatest value to them and of comparatively little importance to the electric manufacturing companies. The question which determines the value of a device to a manufacturer is almost wholly "What is its first cost?" and to the inexperienced purchaser the first cost is the only definite and tangible method of determining the comparative cheapness of various apparatus, when each manufacturer claims the highest possible degree of perfection for its particular apparatus.

The present methods of controlling street cars are the principal weakness in an otherwise beautiful system of propulsion, but the operating company is the sufferer and not the manufacturer. The damage and annoyance to the public due to the "deadly trolley car" is borne by the street railway companies. Let the purchasing street railway companies demand motors which can be started economically, smoothly accelerated, quickly and smoothly stopped, rapidly reversed when going at full speed, and all by the movement of one lever without any injurious strain or sparking upon the motors, and they will find at least one and probably more than one method by which this can be done and responsible companies guarantee it. The manufacturers are supplying the demands of the street railway companies. It is the street railway companies who must demand and secure the improvements which already exist, but which, not being controlled by either of the two great electric railway manufacturing companies are naturally not promoted by them.

I claim the following advantages for my system of control:—1st. The car will be started with not more than one quarter of the current at present required from the trolley. 2nd. The acceleration will be more smooth and more rapid than by the present methods. 3rd. The car can be brought to rest with perfect smoothness, without any mechanical brakes, with an actual return of energy to the system, and in one half the time at present required. 4th. The car can be reversed when going at full speed without any injurious strain upon the apparatus, and with perfect smoothness of motion. 5th. The motor armature can be wound for a low voltage, such as 125 volts, independently of the pressure on the trolley line and hence the insulation requirements and chance of burn out will be reduced. 6th. The street cars can be run by either the continuous or alternating system. 7th. Much greater distances can be covered from one central station and with less cost in conductors. 8th. An existing power plant will operate from 50 per cent. to 100 per cent. more cars than it can operate to-day. 9th. No power is wasted in a rheostat. 10th. No mechanical brakes are used in the normal operation of the car. 11th. The entire control of the car is affected by the movement of one lever. 12th. The chances of burning out the apparatus are practically removed as compared with existing methods.

I find that the manufacturers are making satisfactory profits on the present equipment, and that no manufacturing company could make an additional profit out of the above described improvement, unless it could secure and maintain exclusive control of the improvements. With the operating companies it is entirely different, and the question is "Have the above described features a value for them, and if so, why do they not secure such value when it can be obtained by them immediately?"

THE MOUNT VERNON ELECTRIC RAILWAY.

MR. C. P. ELIESON, the inventor of the storage battery system in use upon the experimental road at Mount Vernon, N. Y., informs us that the board of directors, having met and taken action, have pronounced the road satisfactory even beyond their expectations, and that two more cars will therefore be equipped and operated on the line. The 200 extra batteries required will be made in Mount Vernon.

This railway was fully and exclusively described in THE ELECTRICAL ENGINEER of Sept. 20.

DATA FROM THE TERRA HAUTE, IND., ELECTRIC ROAD.

THE results that can be accomplished in the power stations of the smaller electric railways is well illustrated by the following data from the power house of the Terra Haute, Ind., Street Railway Co. The station has a Westinghouse equipment throughout, both in engines and generators, there being one compound non-condensing engine, 330 h. p., and two of 180 h. p., belted to the generators. The log of this station is carefully kept, and as it runs quite uniformly from day to day, the record of a single day is abstracted as a fair average:

Total hours run, operating cars.................... 17¼
Total engine hours run............................ 18
Maximum number of cars running:
13 cars, each having one 15 h. p. double reduction motor.
2 cars, each having two 15 h. p. double reduction motors.
7 cars, each having one 20 h. p. single reduction motor.
Making 22 cars and 24 motors. There were also seven trailers.
Boilers running, two 54" x 16', 60 h. p. each.
Engines running, one 18–30 x 16 Westinghouse compound.
Steam pressure.............................. 110 lbs.
Amperes.................................. 95 to 350
Voltage.. 500
Car mileage.................................1,940
Coal, bituminous slack (poor quality, evaporating about 4 to 1).
Cost of coal per ton, delivered .... 90 cts.
Coal used in 18 hours, including banking...... 11 tons.
Cost of coal per car mile.................... .51 of a cent.

A note on the report of this day shows that the weather was hot and dusty, and that the cars pulled hard. Also, that the circuit breaker opened an unusual number of times on account of heavy load. The ampere readings on the record sheet, while indicating occasionally heavy loads, frequently ran quite low, showing that the service was subject to very wide fluctuations, as would be expected with a plant of this size.

SOME ELECTRIC RAILWAY STATISTICS FROM TROY, N. Y.

WE give below a few interesting figures from the Troy City Railway Company and its leased lines for the year ending June 30. They give an excellent idea of averages, expenses, etc. Betterments as follows: Electric appliances, $6,357; buildings and fixtures used for electric purposes, $13,908; purchase of constructed road, buildings, etc., $130,978; motor cars and fixtures, $40,274. Total betterments, $188,266. The total year's operating expenses, $228,584, include the following items: Repairs of roadbed and track, $9,084; repairs of buildings and fixtures, $2,900; repairs of cars, not motors, $3,274; repairs of motor cars, $10,076; salaries of general officers and clerks, $16,439; wages of conductors and motormen, $84,992; wages of engineer, firemen, etc., $9,256; wages of watchmen, starters, etc., $14,025; light and fuel, $1,951; fuel, light and other supplies used at power house, $8,922; damages to persons and property, $6,198; legal expenses, $2,058; advertising, printing, etc., $2,445; removal of snow and ice, $5,211. The total length of all tracks and sidings owned and leased by the company is 29¾ miles. The company's rolling stock comprises 26 box cars, not motors; 21 open cars, not motors; motor cars, box, 50; open, 50. The total number of passengers carried during the year is 8,621,580. The average number of the company's employés is 350. There were 14 accidents on the several roads during the year, of which two were fatal.

ELECTRIC RAILWAY CONSOLIDATION AT NEW ORLEANS, LA.

NOTICE has been given that a special meeting of the stockholders of the New Orleans City & Lake Railroad Company will be held on Oct. 30, to ratify or reject the contract with the New Orleans Traction Company, Limited, and to vote upon an increase of the capital stock of the company to $2,000,000, and the deliverance of the added stock under the contract which has been made by the directors.

It is said that the contract referred to is similar to that entered into with the Crescent City Railroad Company, under which increased stock and an issue of bonds are to be turned over to the Traction Company, and the latter is to assume all the expenses of rebuilding and operation, and pay the stockholders a certain guaranteed dividend on their stock. As the Traction Company purchased a majority of the stock under the deal which was engineered by the late Colonel Joseph A. Walker, the proposition only requires the formality of a final acceptance. It is also reported that the Traction Company does not intend, for the present, to convert all the lines of the City and Lake Railroad into electricity, but to make several short connections with the Judah Hart Railroad, now in progress of construction, so as to make it an early and active competitor of the Carrollton railroad, leaving the rest until the finances of the country are easier.

ELECTRIC ELEVATOR IN THE WORCESTER, MASS., ELECTRIC CAR HOUSE.

A FRISBIE electric elevator in the car house of the Consolidated Street Railway, Worcester, has been successfully tested. The trial test consisted of raising one of the heavy cars to the upper floor. The elevator is said to be the largest electric elevator ever built in the United States. It consists of a platform 34 feet long, 15 feet high and 10 feet wide, weighing 6¼ tons. This is guided at four points and suspended in the centre by wire ropes, any one of which is capable of lifting a maximum weight of nine tons without danger of breaking. The steel beams which carry the sheave wheels, over which these ropes pass, weigh with their supporting columns more than four tons. The motive power for this elevator is supplied by a 20 h. p. electric motor of the Westinghouse make. This motor derives its power from the trolley circuit. The railway company will use it for lifting their cars from the ground floor to the second story of their building whenever storage or repairs are desirable.

IMPROVING CAR CONTROL AT CINCINNATI.

THE local electric railroad companies are opposed to the following rules lately adopted as to car brakes and switches by the Board of Administration:

Each and every person, company or corporation operating a system of street cars propelled by electricity shall place on each and every car operated a switch in multiple arc with the safety fuse, and in a position where the motorman can have free and easy access to the same, so in case the fuse blows the switch can be cut in instantly, thereby stopping the car by reversal of current to motors.

Each and every person, company or corporation operating a system of street cars propelled by electricity shall place on each and every car an improved air brake, capable of being operated by motorman or conductor.

Each and every person, company or corporation operating a system of street cars propelled by electricity shall arrange the circuits in each and every car whereby by the throwing of a switch the motors can be converted into generators, said switch to be placed within free and easy access to motorman.

Each and every person, company or corporation operating a system of street cars propelled by electricity shall place on each and every trolley arm a trolley wire finder.

ELECTRIC RAILWAY EARNINGS AT BINGHAMTON, N. Y.

PRESIDENT ROGERS furnishes us with the following excellent statement of the earnings, etc., of the Binghamton Railroad Company:

RECEIPTS AND EXPENSES FOR JULY AND AUGUST, 1893.

Passenger receipts	$24,490.28
Receipts, other sources	196.35
Gross receipts	$24,686.63
Operating expenses, including pro rata taxes and insurance	10,753.97
Gross income from all sources	$13,932.66
Interest on funded debt	2,166.60
Net income for two months, from all sources for stock	$11,766.06

HOW TO OVERHAUL A FAST TEAM.

AT Cincinnati, Ohio, a few days ago, an officer of the peace, wishing to catch up with and stop a horse and buggy that were being driven at breakneck speed by two drunken men, boarded an electric car and begged the motorman to "let her out." The car lever was at once put over to the last notch, and after awhile the car actually overhauled the buggy, when the officer duly made the arrest.

ELECTRIC CARS WANTED IN HARTFORD, CONN.

THE Revd. F. S. Root is among the citizens of Hartford who are warm in their advocacy of the trolley system for that beautiful town. He has a strong, shrewd and manly letter on the subject in a recent *Hartford Post*, and quotes in the approval the remark of the Hon. H. C. Robinson, that: "Hartford suffers daily in reputation and convenience by the failure to introduce electricity as a motive power."

MORE TROLLEY ROADS FOR BROOKLYN, N. Y.

THE NEW YORK STATE BOARD OF RAILROAD COMMISSIONERS has handed down a decision giving the Brooklyn City Railway permission to change its motive power from horses to electricity. The work is already in hand and will give a considerable extension to the trolley system in the city of churches.

ELECTRIC EXPRESS SERVICE.

IT is proposed to introduce an electric express service on the trolley lines of the Lynn and Boston Street Car Company. The Consolidated Traction Co. are said to contemplate similar work for their system between Newark and the Hudson River.

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ELECTRIC LIGHTING ON BUSINESS PRINCIPLES.

THESE are times when, if ever, an electric light plant should be operated on business principles. Not long ago, an interesting discussion took place in our columns as to the limits within which a plant of moderate size might be made fairly profitable; and it was pretty clearly shown that while some such stations might yield handsome returns, the prospects of a great many were not such as to grow enthusiastic over, under any circumstances. Their success depends, as does that of many small enterprises, on strict economy, close personal management, and the satisfaction or conciliation of customers. Just now, when the burden of an unparalleled depression has been weighing heavily on industry of all kinds and when the public in every community has been cutting down expenses, it becomes a local company to give the best service in its power, so as to hold all the patronage possible.

We fear, however, that in many instances recently, economy has been regarded as synonymous with and to be accompanied by inefficiency. We can understand indifference at any time in the management of a municipal plant, and hence have not been surprised lately that cities short of cash have been giving bad service from their stations. In one city, for example, the local newspaper remarks that it has "an expensive electric light plant, yet it furnishes about as much illumination on a dark night as a bucket of tar." It recommends that the plant be run on business principles, when it ought to know that to run any city department anywhere on business principles is as impossible as for flagstones to yield crops of bunting.

When we turn to private enterprise, we have a right to expect that mere selfish interest will keep a plant up to the proper standard especially as the income will be so cut down by other people's economy as to make the smallest rebates for bad service a serious matter. But we have seen not a few complaints lately, and it is to be hoped that the number is no greater than is indicated by what has fallen under our eye. The following item may be taken as a sample:

QUEER PYROTECHNICS.

THE old inhabitants of this town were reminded of their boyhood days last night in the appearance of the stores on the principal thoroughfares in regard to the illuminations. In some places tallow dips were in use, in others pine knots, in others lanterns punched full of holes, and jack lanterns adorned the ceilings. The occasion of all this was the usual monthly break down of the dynamos in the electric light station. The lighting system of this town is, if possible, a worse fake than the present system of sewerage, and if something is not done at once merchants will put in their own power and depend entirely upon themselves for light. This can easily be done and, at a greatly reduced expense, the light will be clearer and purer than ever produced by the present illuminating company. Promises made by this concern are like those of the drunkard, made only to be broken, and the hope of better lights, gas or electricity, is more remote than ever. Who is responsible for this miserable condition of affairs? Who will remedy it, and when? If a tornado should strike this town and any building was fated to be blown out of existence, this concern's building would be the least missed. Generally speaking, institutions belonging to non-residents are very irregularly taken care of, doubtless for the reason that the non-resident owners don't care a fig whether satisfaction is given or not so long as they are saved from the annoyance of paying out money for improvements.

Yet we suppose that if a competing local company with intelligent management were to enter the field and give good service at fair rates, from apparatus that did not break down every month, there would be a frightful howl about the iniquity of it.

It goes without saying that the company thus scored is not a member of the National Electric Light Association. The mere fact of its membership would be an evidence of its desire for better things. It would also be money in the pocket of such a company if it were to employ an electrical engineer or expert to look over its plant and circuits once in a while for the purpose of correcting evils and suggesting improvements.

STREET CAR FENDERS.

THE attention paid just now to fenders for all classes of swiftly moving street cars is highly commendable, and it may be expected that some useful forms will soon emerge from the hurly burly of competition. But the main aim must be to put the cars under such perfect control that the necessity of car fenders is reduced to a minimum. At present owing to the insufficient control, the necessity for fenders is greater than it has ever been before. In some cities the demand has arisen for slower cars, but that is absurd when we remember that the chief reason for the adoption of electricity is that it affords higher speed. Granted that with higher speed we have heavier cars, the need for improved control becomes immediately apparent; and that is exactly the condition of the hour. We publish an article on the subject in this issue, from Mr. H. Ward Leonard, and shall print others in succeeding issues with the object of bringing the question to some fruitful stage.

A Word Only.

THE ELECTRICAL ENGINEER will not emulate the course of the *Electrical World* in filling its columns with details of personal litigation and its own argument thereon. We are glad to know that our readers and patrons prefer other topics, and that the character and purposes of THE ELECTRICAL ENGINEER are sufficiently well known and understood to preclude the necessity of defending Mr. Martin or any member of its business or editorial staff from attacks such as that printed by our contemporary in its issue of Sept. 30.

G. M. P.

DISCUSSION ON MULTIPHASE MOTORS AND POWER TRANSMISSION AT THE INTERNATIONAL ELECTRICAL CONGRESS.—III.

PROF. H. A. ROWLAND: With regard to whether the dynamo should be arranged for small potential or large. Suppose you wish to get 20,000 or 30,000 volts, or even 10,000, what is the best process to use, to use the transformer or to use a dynamo giving the 20,000 volts? We have just heard a calculation on this subject which intimated that the use of a transformer in a 5,000 h. p. dynamo would be equivalent to losing a capital of $60,000. Well, now, what is that based upon? Practically that is 150 h. p. that you lose, and where does that 150 h. p. come from? It comes from a turbine, from water. Water comes from Niagara Falls, and if they turn on a little water, which is generally the rule, they would not lose an amount of $3,000 a year. I certainly would dispute that statement. The only case in which the 150 h. p. would come in would be when you were using the turbine up to its maximum efficiency. How often would this happen? All electricians know, even I, the pure theorist, know that only once or twice in a day do we use the turbine up to its full power, and as to getting an extra $3,000 out of this 150 h. p., why, I would very much dispute that. That would be one point. Therefore, as we all know, a dynamo to give 10,000 h. p. or 20,000 h. p. is a very uncertain thing. I do not know of any in the world that are running with satisfaction.

Now, as to the transformer, that is quite a different affair. How do we make a transformer so as to stand the 10,000 volts? Why, we do not insulate the wire for 10,000 volts. We build it up so that the first section shall give 1,000, the second section 1,000, the third section another 1,000, and so on until we get 10,000 or 20,000 or 30,000 volts, so that it is a perfectly easy matter to build the transformer for 100,000 volts in this way and only insulate it at every point for 1,000 volts. But it is quite a different affair when you come to treat of a dynamo. What is the one point on which the value of a dynamo depends? Why, it is the amount of copper that you get in the groove. If you have a groove in the armature it is the amount of copper you can get in the groove as compared with the size of the groove. As you go up in potential this amount becomes less and less.

As far as I have talked with practical men on this subject it seems to me they all agree upon this point, and I therefore think that instead of $3,000 a year being saved by the use of the dynamo without transformers, that it would probably cost many times more than that, and instead of that being saved you would lose much more than that in burning, repairing and everything of that sort.

Now, the question, as I understand, is that of transmission, and I have not heard anything said about the period of the current—the frequency. Of course in power transmission that is the most important thing; that is a fundamental point to be decided first. What shall be the frequency? What is the effect of frequency? We all know the effects of high frequency. Now, is there any lower limit, for the higher limit is perhaps less desirable. A lower limit, I believe, has never been studied. The lower down you go, the only effect that most persons observe is that the transformers have to be made larger. That seems to be the only effect which is mentioned, although it is known very well that a frequency of 40 or 50 will blot out the arc lights. A frequency of only 30 makes the incandescent lighting barely possible. When you get down below that we have nothing but pure transmission. Now, shall we go and operate that and keep on down to 4, 5, and finally down to 1 per second, and then we go into continuous current? Where shall we stop? If we do not stop at the 30 or 40 which would allow a little lighting to be done, then the only thing to be considered is the power transmission. Finally we get down to such a small number that we cannot reduce it any more, and then we have to slow up the machine, so of course, that is one of the limits, when we have to run the dynamo with such a small speed that its contact is less than we wish, and then we have to increase the speed, because the output would be very small indeed. But suppose that that condition does not apply. Suppose the dynamos are already going very, very slow, so that we can get four or five per second. How does the dynamo run under those circumstances? If it is a two-phased machine it runs pretty well with the same amount of power taken off of the circuits, because they balance each other pretty well and make the motion of the dynamo pretty even; but if you should use one of the circuits more than the other, or throw out one entirely so as to have a single phase dynamo, then you will, of course, get a tremor. If the frequency was four a second, there would be a tremor of 16 times a second, and this is so great under some circumstances that it may produce a very great vibration of the machine.

Then take the case of the transformers. They will have to be increased in size, I think the ratio is that with 10 per second it would be five times as large as with 50 per second.

PROF. DUGALD C. JACKSON: When this discussion was launched upon the meeting yesterday, we seemed to have stuck very closely to the question of transmission of power over comparatively short distances. This morning we have gone on to what may be called really long-distance transmission of power. The transmission of power over comparatively short distances we are all acquainted with. We have been referred to plants in Switzerland, in Italy, in France, Germany and other European and Transatlantic countries. If we study these plants we cannot but be struck by the solidity of the construction and design and the successful operation with which their projectors have enabled them to do their work. However, with all due deference to the designers of Europe, especially M. Thury, I would say that equal plants can be found even in our American cities. Taking Chicago alone for an instance, there are motors on circuits in Chicago up to over 100 h. p. in capacity each. The largest motor in Chicago has a capacity of more than 100 h. p. on stationary circuits, and while these motors are all within the city limits, it is some distance from the station to the motors. I do not, however, consider that this is really long distance transmission. The transmission of power can be divided roughly, and when we make divisions we make them merely as rough guides to our minds, because all divisions overlap and are interlaced absolutely. We can divide the transmission of power into three divisions; first, the distribution directly from a central station; second, the transmission of power from a station to motors in a single shop; and third, the long distance transmission of power with distribution from the other end of the transmission, and the plan that is apparently bound to come into prominence all over the world will be the transmission and distribution plant.

DR. LOUIS BELL: The question arose yesterday with some pertinence as to the regulation of the inter-connected circuit polyphase systems. As an experimental fact it is quite easy to regulate a tri-phase interdependent circuit system so as to fulfill easily all the requirements of commercial distribution. It is possible by arranging any system badly to get bad results, and there may be arrangements of transformers and arrangements of systems that will give bad results, but with a properly designed tri-phase system the regulation is well within commercial limits; and variations such as have been mentioned by Prof. Forbes, although they do exist, are of a magnitude that is not of the slightest consequence in a practical case, because we never expect three-quarters of the load to be on a single circuit, nor would it ever be in any of the large problems with which we have to deal. Regulation under these circumstances is far better than the regulation of a three-mile system of direct currents, under even a very much smaller variation of load between the sides. In fact, these objections of regulation urged against the inter-connected polyphase systems are precisely the same objections which were raised in the early days of three-wire direct current systems, and they have even less practical importance. It was said that the three-wire system could not be regulated well; that it would not test well; that we were going to meet all kinds of difficulties in its use, and yet of the continuous current central station lighting, I should say that not less than 85 per cent. is done by this "badly regulated, difficult to manage" system, and I think we are going to have the same experience with the alleged difficulties of inter-connected polyphase systems, whether two, three or more phases, it makes little difference in that respect.

Another interesting question with reference to these problems of distribution comes in the use of the rotary transformer. While, like Professor Forbes, I would like very much to see a commutator converting alternating into direct currents economically, I am not quite so hopeful as he is about it. I do not doubt that it could be done for small currents for arc machines for example, just as we can build enormously high voltage direct current machines for small currents. When it comes to handling 1,000 kilowatts, I think that we will all be grayer and balder than we are now before we see it done by direct commutation. I do not think it is an impossible problem, but the difficulties are pretty serious, whereas with the rotary transformer we have to-day a very efficient and effective means of securing direct currents from alternating, or still more easily from polyphase circuits. The rotary transformer such as we have just described is a machine which instead of having 85 to 90 per cent. of efficiency, has from 90 to 95 or 96 per cent. of efficiency, owing to the connections in the armature, which were well explained by Dr. Duncan yesterday. It will be seen readily that the efficiency of the machine should be at least as high as in an ordinary direct current generator, so that, although I earnestly hope we may have the commutator, I think we will be very foolish to forget that we have now a thoroughly reliable and very simple piece of apparatus which will do the work and do it promptly, if necessary.

One of the most interesting questions which can well be raised is that one which Professor Forbes and Professor Rowland have been discussing this morning, that of step-up and step-down transformers versus machines giving the potential directly. We know what the step-up transformer will do. We do not know yet what the 30,000 volt dynamo will do. Personally I am inclined to believe that if the machine is large enough, 30,000 volts can be gotten from a stationary armature with a fair degree of success, but as the units get smaller the difficulties increase enormously and the ratio of copper to chamber section in the armature gets worse and worse. As the machine gets smaller it gets harder and harder to build the machines for the high voltage, simply because the same amount of insulation is necessary for the given voltage,

whether the output of the machine is 100 or 1,000 kilowatts or more. For extremely large machines I think that the high voltage can be met successfully, but for small machines, although it can still be done, it is, as Professor Forbes has very well said, at the expense of output.

Following the same course of reasoning, the difference between large and small machines as a commercial matter, applies also to to the periodicity. The bigger the machine the lower the periodicity which you can economically get out of it. It is vastly easier to build a machine of 1,000 kilowatts for 50 periods than it is for 125 or 130.

Now, finally, I want to take up the question of the line, particularly with reference to very long transmissions such as have been mentioned by Professor Forbes. Incidentally I may remark that I am sorry to say that the position taken by the State of New York with reference to those Erie Canal experiments is not as hopeful as it was suggested. Instead of undertaking experiments for the benefit of the commonwealth they have righteously granted permission to the various electrical companies to carry on experiments on the Erie Canal, at their own expense, provided they do not disturb the banks. The State is unwilling even to furnish the canal boats, so that I think the probability of the immediate utilization of electric power on the Erie Canal is not so near as it might be. But with reference to the very long lines, I want to call attention to two important factors in success. In the first place, the inductance of the lines which was brought to our notice by Professor Silvanus Thompson yesterday, and in the second place the frequency. As regards the inductance of the line, it is a fact not, perhaps, generally known, but nevertheless a fact, that the tri-phase or other polyphase inter-connected systems for the same energy transmitted at the same voltage give a lower inductance total on the line as, indeed, might be expected from the saving of copper effected. With the tri-phase inter-connected system, the inductance is a little less than $\frac{4}{10}$ of what it is on a single phase or independent circuit, multiphase system.

As regards the frequency, in order to keep down the inductance of the line under ordinary circumstances it is necessary to drop the frequency as the distance increases, and as Professor Rowland has well said, there is both an upper and a lower limit to the frequency. The upper limit would strike out within practicable distances less than the frequency that is now ordinarily used—125 or 130 cycles—which would not be a good frequency to use over a transmission line for reason of induction even providing the motors would do equally good work, which they will not. The lower limit is practically established in the ordinary distribution plant by the necessities of incandescent lighting. Below 30 periods; in fact, below perhaps 33 periods, to give a little margin of safety, 37 or 35, incandescent lamps do not work well; they flicker and even before they begin to flicker perceptibly they produce an effect on the eye that is very disagreeable. In the same way the arc lamps, even with the best soft cored carbons at 45 or 50 cycles work quite well, the working being bettered by the use of a reflector to get all the light together. At 60 cycles even they give trouble with American carbons, so I think our practical limit of frequency of a lower limit is about 30 to 35 cycles. Anything below that should be employed for motors only, and I should consider it rather bad engineering to employ it even under these circumstances, inasmuch as it means making a special plant, and you can get excellent results at 30 to 35 cycles.

Finally, passing by the inductance on the line, we must recognize that there will be a point at which we must lower the frequency below 33 cycles. That point will not be reached in more than two per cent., I should say, of the transmissions that we are likely to undertake in the next ten years, but when it does come, we must be prepared to meet it squarely and lower our cycles or use direct currents. We can lower the cycles, and then we must reconvert; reconvert either to direct current or higher cycles, and this process will probably have to be used at very long distances, such distances, for example, as that from Niagara Falls to Albany.

And finally, as regards the keeping up of the line. I think is it a most serious problem that confronts the engineer in undertaking power transmission. I remember being given a very bad quarter of an hour occasionally going out to California over the Santa Fe last spring, and seeing every bridge target from Kansas City to San Bernardino perforated with from one to 25 bullet holes. The keeping of a long line especially from malicious injury is a serious matter, and the worst of it is that the underground conduit, in nine cases out of ten, from a commercial point of view is absolutely prohibitive. It would not pay. If we confine ourselves to underground conduits, then we will never get any transmission work done in this country, at least, except in isolated cases, because the cost is too enormous. For most of the overhead work we must employ bare wires, for insulation at 20,000 or 30,000 volts is simply lulling one into a false security. No insulation that is practicable to be put upon wires will stand that voltage, and still remain intact through any period of time. The striking distance of a 20,000 volt current is something prodigious. We will have to put up the bare wires with the best danger signals that can be devised, even the skull and cross bones, if necessary, as they have on the Frankfort line. The sooner we recognize that fact and face it, the easier it will be to get power transmission. The conduit is all right in theory; it will secure practical, uninterrupted operation of the lines, but as a commercial matter it is in nearly every case that comes before us, prohibited. By conduit I mean a subway large enough for a man to go through and inspect, and any less means of putting the wires underground is objectionable, as Prof. Forbes has very well stated.

As regards distances which we are prepared to tackle to-day, I do not think anyone of us would care to state an exterior limit. The cases that practically come up are many more of them below 20 miles than above it, and many more below 50 miles than above it, so that we have enough to keep us amply busy for the next decade in developing the powers which lie within 25 to 50 miles of the points at which it is desired to utilize them. Over such distances even to-day I do not think we need have any doubt whatever of success. For greater distances the problem resolves itself more into a commercial one than an electrical one.

MR. CHARLES S. BRADLEY: There is one point that has come to my mind that seemed good to suggest, and that is in the distribution of high polyphase systems the motors will help out on the equalization. Should there be any drop due to a difference of load, the motors being on all the inter-connected circuits, the motors, especially if they are synchronous, will tend to help to keep the distribution even, keeping the voltage even.

MR. C. P. STEINMETZ: Something has been brought forward against the polyphase systems. I do not believe in the polyphase systems very much myself. I consider them only as a state of the art which we have to use now because the single-phase system is not developed as yet sufficiently to place entire reliance in it, but I hope very soon the polyphase system will be gone and we will have the single phase.

With regard to the high potential dynamo, we have differences. One says the most recommendable way is to build the alternating generator of very high potential, 20,000 or 30,000 volts. The other says it is preferable to build the machine for low potential instead of a high potential. I believe that if one tries to build our present alternating polyphase machines for anything more than 5,000 to 6,000 volts, he will get badly left. I think it is utterly hopeless to build our present forms of alternating machines for these potentials like 20,000 volts, but on the other hand what can we do in the transformers to make them safe for 20,000 volts? Why shall we not do the same for generators? The only question is dollars and cents, really. That is the test, the cheapest way. Is it cheaper to build machines like the transformers designed to stand these very high potentials, or is it preferable to use transformers and to build the machine for a low potential? It may sound very hard to say that it is only a question of money, but a scheme may be as feasible as you like but it will never be carried out if it is impracticable from a financial point of view.

In running the line you find the same condition again. You already have conduits running all over the country, oil pipes. Oil is a splendid insulator. Mains laid in oil pipes would be a very good way to have the best insulation. You could get rid of all the insulation and everything else, and still reduce the expense by a good deal. The self-induction is a very serious bugbear. It is a difficulty as long as you do not know how to calculate it and handle it and compensate and eliminate it, but as soon as you are able to do that the self-induction will change from your enemy and become perhaps your best friend.

MR. N. S. KEITH: I have listened to this discussion upon polyphase systems and I find that they are essentially theoretical and based upon what is to be done. I can refer to constant current transmission as a thing which has been accomplished and which is in practice. Whether one will be preferable to the other I doubt, except in special instances where one is more applicable than the other.

As Prof. Forbes spoke of the immense power of Niagara which he proposes to distribute over a great portion of the State of New York, it occurred to me to say something to the Congress about the immense amount of power available, in the mountains of the Sierra Nevadas, extending all the way from Alaska to Patagonia. In all these places we have an accumulation on the mountains of immense bodies of snow during the winter. As these snows melt in the spring they pass to the sea through many rivers, and the fall from these accumulations of snow before reaching the sea or the level of the arable land below is exceeding great, running from 7,000 to 10,000 feet in height. This makes at almost regular intervals through the State of California rivers which run parallel and discharge great quantities of water into the sea. This quantity varies when unrestrained from an exceeding large flow to a minimum flow at about this season and later in the year. We have there a wet season and a dry season, the summer season being dry and the winter wet. During the winter rains fall in the lower counties and in the highlands, snows. Taking advantage of these facts years ago, extending back 40 years even, ditch companies, as they are called, built canals or ditches from the higher sources of these rivers and carried them around the mountain sides, oftentimes with great engineering ability and with great expense. Those ditches exist to-day and they are almost innumerable. They run into the hundreds, but there are many of them which have been combined into companies and

these companies pursue the plan of selling this water which they accumulate at the heads of the rivers for various purposes for power and for irrigation. But in order to use it for power among the mining sections of the country more especially, they have to drop it from the higher levels frequently into lower levels, in order to carry it to the point where it is desired. There are many places in the mountains where power is requisite which cannot be supplied by means of these waterfalls and water from the ditches, and I will briefly recite the case of one ditch company in order to show the immense amount of power which they have at their command and how little available it is at present.

There is one company which has reservoirs at an elevation of 7,000 feet above the sea, both natural and artificial, with an accumulation of water which enables them to use 5,000 miner's inches per day continually. The hydraulic engineer will tell you that for a rough approximation one inch, miner's inch, would equal about one and a half cubic feet per minute falling a distance of 400 feet, which will give 1 h. p. We obtain 87,500 h. p., which this one ditch company alone has available for power purposes. The water is not required for irrigation except in a small area until it reaches the lower level, nearly the level of the sea. By utilizing this water by electric power and still selling as much power as they now do by the direct application of water, they can have all this amount of water to sell at the lower levels at a price which is now 80 cents a miner's inch per day. They sell the water for power purposes in the mountains at prices varying from 10 to 20 cents per miner's inch. By locating dynamos at the various falls which are available from the level of one ditch to another, they can utilize nearly all this power. But say that from losses and from amount drawn out for irrigation at various places this power is only 50,000. It gives them then from three to four times as much power as they now can and do sell. From that, of course, there would be losses due to the generation of electricity and the transmission, but even then this comparatively small amount of power could be supplied at a far greater profit than they now do, with greater benefit to the miners of the state. Wood is getting very scarce. It is burned off in the most available sections and power is desirable. Many mines are closed simply because the power necessary to operate them is too costly. By arranging a system of this kind, either for the ditch companies or for those who may become associated with them, the mining interests of this section of California and Nevada will be very much increased. We will then produce some of the gold which seems to be so desirable to increase our currency.

Mr. Hermann Lemp: I am connected with a concern which is in a great measure dependent upon the system or systems through which the mechanical energy is brought to the consumer to be utilized and transformed into the particular form required for his business. I fully agree with Prof. Silvanus Thompson that the simplest system is the best, and that it is far better to use more complicated methods in individual applications, even at the expense of economy, than to make the whole system a complicated one for the sake of alleged economy or beauty of a new scheme.

Dr. Duncan has asked the question, Can any one having had practical experience with rotary transformers of the single winding type state how much more energy can be transmitted electrically through such a transformer as compared with the amount transmitted mechanically? While these are not the exact words used by Dr. Duncan, I think they express his meaning. Before I answer this question I will briefly state the circumstances that lead me to use the rotary transformer and under what conditions it is used practically.

While commercially introducing the Thomson electric welding process, we were confronted by the great first cost of machinery as one which seriously appeals to the pocket book of our would-be consumer. Electric welding demands considerable power, it is true generally for a limited time only, but it must have the power when needed just as much as a street car cannot limit itself in this country to the seating capacity as it is done in Paris. Our customer must be able to burn his specimen to be welded all to pieces if needs be, with bad or good contact. But our customer has not always the power to spare, and if he has to acquire special engines and boilers he must provide them of a larger size than would be necessary if the generator could be worked on a constant load factor. Hence the great first cost of a welding plant, and I may add that all of you that need steam power know the engine to give it must be sufficiently large for the maximum power required, that even with a fly wheel of ordinary dimensions there is no elasticity in a steam engine. You exceed its capacity and it comes to a stop. Not so with an electric motor. There is a great elasticity in an electric motor. You overload it and if the fuse stands it the motors generally will give you for a short period 50 or even 100 per cent. more than its rated capacity.

This suggests the following: 500 volt power circuits of the continuous type are being erected all over the United States for street car work. Our standard in direct welding requires a primary voltage of 300 volts alternating. Now, is there no way by means of which we can get one from the other? The motor dynamo with two separate windings was thought of, and in a happy moment the idea suggested itself to me to connect two points at 80 degrees apart of a two-pole 500 volt motor, with two collecting rings and construct as it were a revolving pole changer with self induction to prevent sparking. I had for a moment the presumption of congratulating myself upon a new and practical scheme, but only a few days later I found it to be one of the reinvented foreign inventions alluded to before by some of my learned friends and had I better understood the almost classical book on dynamo electric machinery of our esteemed Prof. Silvanus Thompson, I would have been wiser to start with.

But returning to our subject. Here was a beautiful chance for using the rotary transformer, and our practical results have demonstrated beyond a doubt its usefulness.

You will perceive that the average E. M. F. of an alternating circuit whose maximum is 500 is approximately 345 volts, and inasmuch as our standard voltage for indirect welding requires 300, the additional 45 volts will be used for drop in the conductors, etc.

Now, taking up the question of Dr. Duncan, I will state that if the load in the alternating circuit consists of translating devices without self-induction, and if also the field magnets of the motor are properly laminated, the electrical energy can be transmitted through such a rotary transformer, taking its ordinary output as a motor, at 100 per cent. The lamination of the field poles I consider not absolutely necessary, but expedient to prevent heating of the frame through reaction of armature current, now practically subdivided in two.

A self-inductive load, as found with welding apparatus, causes increased amperage for a given energy, and its immediate ill effect is to cause the armature to race, which, however, has been corrected by a compound wound field. Since no belt is used for transmitting or receiving power, there is no objection to running the rotary transformer at a higher speed than is usual with armatures. By this the output is increased in the ratio of the speed which compensates for the loss in output occasioned by self-inductive loads. A practical application of this rotary transformer has now been in use for the past year, commercially only for about three months, for the purpose of welding street car rails to each other in the street. The machinery consists of a four-pole rotary transformer, nominally 100 kilowatts, actually giving 150 kilowatts. It is compound wound and connected in the usual way to the trolley circuit. The alternating current is conducted to a large transformer, reducing the potential to three volts, with proportionally increased current. This plant has been continually working for three months, day and night, except Sunday, transmitting from 108,000 watts to 150,000 watts in sections varying from 5 to 12 square inches.

Mr. Hasson: In the east you have Niagara, and beyond that there is no waterfall of any particular importance. Water power is not so essential here. Coal is not so dear as it is with us. The question of power transmission in California is a very serious one. It is an absolute essential to us for the reasons that have been given. In many districts there the power costs from $150 to $800 per horse power per annum, which renders manufacturing and the working of mines impossible, and with us it is not the question of the three-phase or two phase or single phase. It is any system that will meet the requirements, and these requirements, briefly stated and broadly divided over the entire country are first, to operate mining districts; that is, power to run mills and stamps; machinery that will run day and night, week in and week out for months at a time. Second, power to run hoists; power to run pumps, which depend upon circumstances altogether, and finally power for lights, which, of course, is a varying load, and is really in those districts more of a luxury than a necessity. The second style of transmission is one for multifarious purposes for a number of cities, and that is, of course, to begin with, to furnish light; second, to furnish power regulated from ¼ h. p. to 500 h. p.; third, for traction purposes. Now, for the purposes of transmitting comparatively large blocks of power for continuous operation, the single phase, synchronous machinery appears admirably adapted when properly constructed. The system does not, however, appear to be sufficiently flexible in the transmission of power for multiphase purposes, and it appears to me from what I have heard here, that difficulties may occur in the line. Our modern engineers have solved this question practically in the development of the multiphase systems as is shown to us in this exposition to-day. I have never seen a better machine in all of its mechanical details than that presented by the two-phase system as displayed in the Electricity Building, leaving out any other considerations. I was surprised indeed to hear it said yesterday by one of the eminent authorities that the multiphase system was complex. I fail to see it. It appears to me admirable in its simplicity. The mere fact that by a single system and by such easy means, power may be generated and used for such a variety of purposes, establishes its claim beyond a peradventure.

The Chairman then called upon Dr. Duncan to close the discussion, which he did, as follows:

Dr. Duncan: Of the points brought out in the discussion it seems to me the most important are these. In the first place it has been shown that we are in a position to use two-phase currents for a great many purposes. Mr. Scott's exhibit here is promising as showing the purposes for which a two-phase current could be used, and the same exhibit could have been made by the General Company with their apparatus.

Another point is whether the two or three-phase system is the best. Again, whether a single-phase system will not supersede

both, and it seems to me that the tendency of most of the foreign speakers and those of the American speakers who have had no practical experience is in the direction of a single-phase system. Those of our American speakers who have had experience and have seen the advantages of the multiphase system are in favor of the multiphase system. The future can only tell which will be best, but certainly the multiphase system at present is the only practical system for general distribution. Another important question that was briefly taken up was the question of the number of periods, and I am sure thas is not only a theoretical question but one of vast practical importance. This is true, I think, if we are going to use the comprehensive system. If we are going to do arc and incandescent lighting, then we must use 50 periods per second. If we go down to very low periods, as has been pointed out by one of the speakers, we put our multiphase motors at a disadvantage, and we greatly increase the lag of the current.

ROOT BOILERS AT THE WORLD'S FAIR.

We illustrate in Fig. 1, the four Root boilers in Machinery Hall at the World's Columbian Exposition in Chicago. The Abendroth & Root Manufacturing Company, who manufacture this boiler, are among the six companies who have placed their boilers in the boiler house of the Exposition—the other boilers being the Moore, the Zell, the Gill, the Heine and the Babcock & Wilcox Companies.

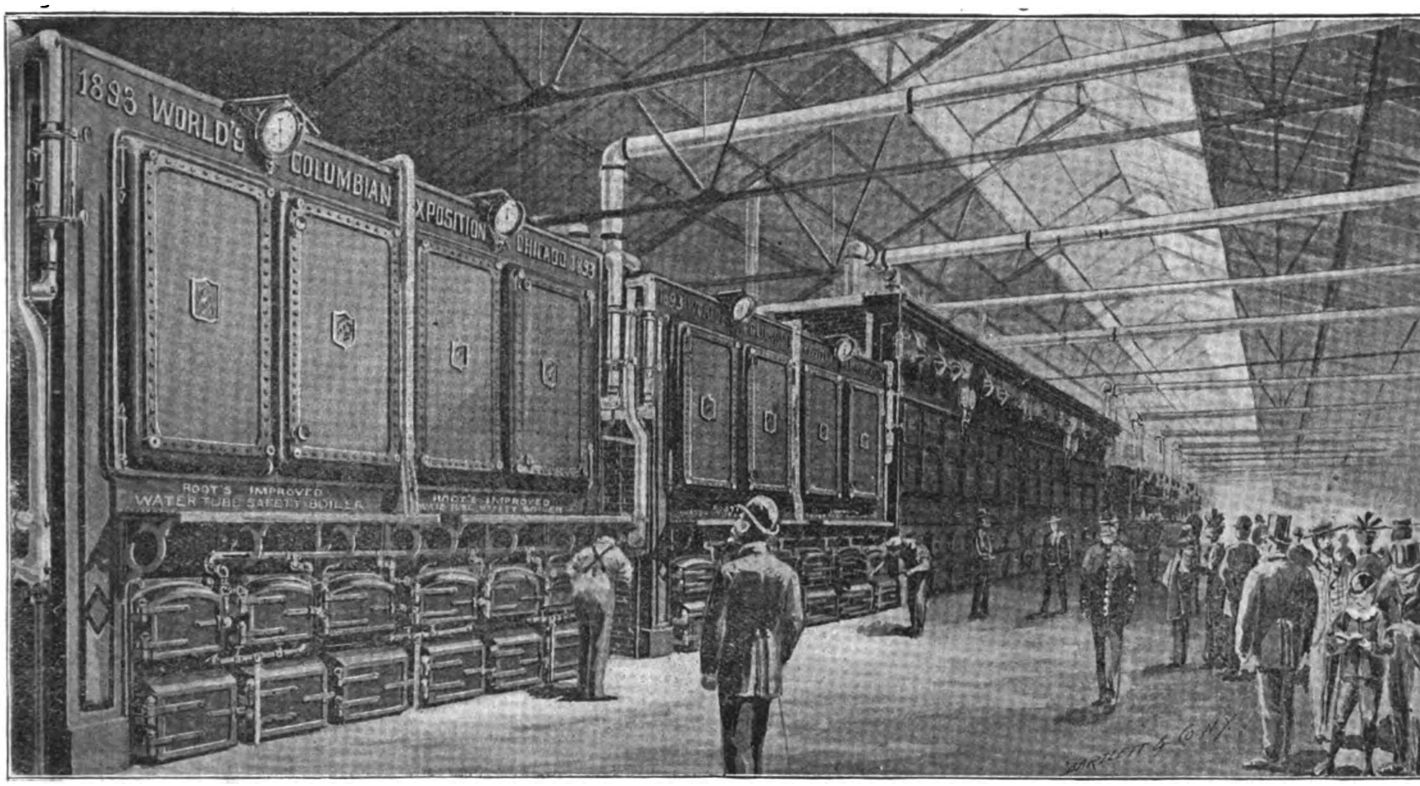


Fig. 1.—The Improved Root Boilers, Machinery Hall, World's Fair.

Fig. 2 shows the boiler in process of erection, and notwithstanding that it is a rear view, brings out very plainly, a number of the distinguishing features in which this boiler differs from all the others of the sectional water tube type. The main part of this boiler is made up of what are termed packages—that is, two parallel boiler tubes, placed about eight inches apart and on each end of these tubes is expanded a cast iron header which is open inside like a box, and shaped so as to secure the greatest strength with the amount of metal used. The end view of the headers presents a rectangular appearance, about 16 inches long and seven inches wide, and in making up the boiler these are piled one upon the other, so that these rectangular faces present the appearance of bricks in a wall—(that is, with their vertical joints broken or staggered). Each tube is thus always over the space beneath, and hence the heated gases, from the fire, are unable to find any straight passages, in their attempt to escape, and so are made to impinge against each tube.

Beginning at the bottom a connecting bend is made to connect a header in the lower row to the next header directly above it. This header in the second row is then connected to a header directly above it in the third row, and so on to the top, where the last connecting bend connects the top header to the overhead drum, and a corresponding series of connections are made with the headers at the opposite ends of the same tubes; and thus it will be seen that a complete vertical section of circulation is made, the water rising in all of the inclined tubes as it becomes heated, passing directly up through the front headers and connecting bends, to the overhead drum; and then the water of circulation passes down, in the rear of the boiler, through the rear connecting pipes—(shown very plainly in the cut) into a drum where it meets the feed water, which is introduced at this point, and there the temperature of the feed water is raised to a point above that which can in any way be injurious to the joints and parts of the boiler.

By referring to the cut again, it will be seen that the water passes from the feed drum directly down into the mud drum beneath, and this arrangement makes it impossible for the mud or sediment to become diverted into the other parts of the boiler, and by opening the blow-off cock, from this mud drum, at stated intervals, the boiler can be kept perfectly clean.

The cut shows, it will be noticed, pipes leading from the top of this mud drum into the bottom of each independent section of the boiler. Thus the coolest water is brought directly to the lower tubes, protecting them, in a great measure from the intense heat of radiation of the fire, while other water ascends naturally, as it becomes heated, up through the rear headers and connecting bends of the various sections and so distributes itself throughout the entire boiler, and thus a perfect and even circulation results. The cut shows the many overhead water drums used in this boiler, one being used for each section, while in other sectional water tube boilers but one or two larger drums are used.

The makers claim that this arrangement gives a much larger liberating surface (the normal water line being in the middle of these drums)—the drums being of small diameter allows a thinner metal to be used, to withstand a given pressure, and thus they become more efficient as heating surface. These make the boiler, it is maintained, more truly a "sectional" boiler, and by dividing the water into a smaller bulk, they make the effect of any possible explosion in the water drum less disastrous. Moreover, by dividing the water into smaller bulks, they give the boilers the facility for making steam more rapidly, and thus enable them to respond quickly to any sudden demand on them for steam; while at the same time, an extended experience has taught that the water carrying capacity of this boiler is ample to hold the steam steadily at any pressure that it is desirable to maintain.

Over the rear of these water drums is seen a multiple, which collects the steam from the steam space of all the drums, and from this multiple it is conveyed through two connecting pipes to a large cross steam drum, extending across the entire width of

this boiler. The end of one of these steam drums is visible over the centre of the water drums of the left hand boiler. Here the steam is taken entirely away from its contact with the water in the boiler. This steam drum is about 8 feet 6 inches long and about 30 inches in diameter. By comparing the volume of steam held in this drum with the volume of steam escaping from an eight inch outlet, it will be seen that the ratio is very great. Hence the steam, when it enters this drum, is obliged to wait, as it were, its turn to escape, and while it is thus standing comparatively still for an instant, it drops by gravity any water it may hold in suspension, which is conducted by piping from the bottom of this drum back into the boiler, and thus, by this means dry steam is insured, and the steam space in the boiler is made extremely efficient.

The connecting bends are shown quite clearly in the cut. These are held up to their place by bolts which have a ball-shaped head, fitting into a socket made to receive them in the headers, which allows a considerable motion in every direction. The ends of the connecting bends are of conical shape and are received into an extremely flexible packing ring, made of a special metal; this ring (the shape of which might be compared to a half opened umbrella), in its turn is received into an angle-shaped seat which is carefully milled out in the header, and when pressure is applied to the end of the bend, through the bolts, the conical end is forced into the ring, and this expands the ring into its seat, the same as a pressure applied to the ferrule end of the half opened umbrella would tend to force it entirely open. Thus it will be seen that a plug joint is used to connect the headers into vertical sections, and it is well known that no steam joint is so easily kept tight as a plug joint.

Another most important feature in this method of connecting the headers is that it makes a flexible vertical section. With the intense heat of direct radiation striking the lower tubes of a boiler, they must have a tendency to elongate more than the upper tubes, which are further away from the fire, and then, it is a well-known fact, that the entire boiler elongates, as it is heated from the temperature of feed water up to that of steam; and the intense heat of the fire, striking against the lower tubes, puts a permanent set in them. In other words, it does not allow them, when cooled down, to return to their original length, and thus these lower tubes keep gradually growing longer and longer. Now, if an inflexible vertical header should be used in place of the flexible section, it is readily seen that a severe strain would be placed on it, increasing with the age of the boiler, which would have a constant tendency to rupture it.

Most of the points which we have described—which are the distinguishing features in the Root boiler—are shown very clearly in this cut, while Fig. 1 gives an excellent idea of the boilers as they stand in Machinery Hall, and are seen daily by thousands of visitors. We are indebted to Mr. A. A. Cary, the mechanical engineer of the company, for data, etc., and for the opportunity to illustrate this really fine plant.

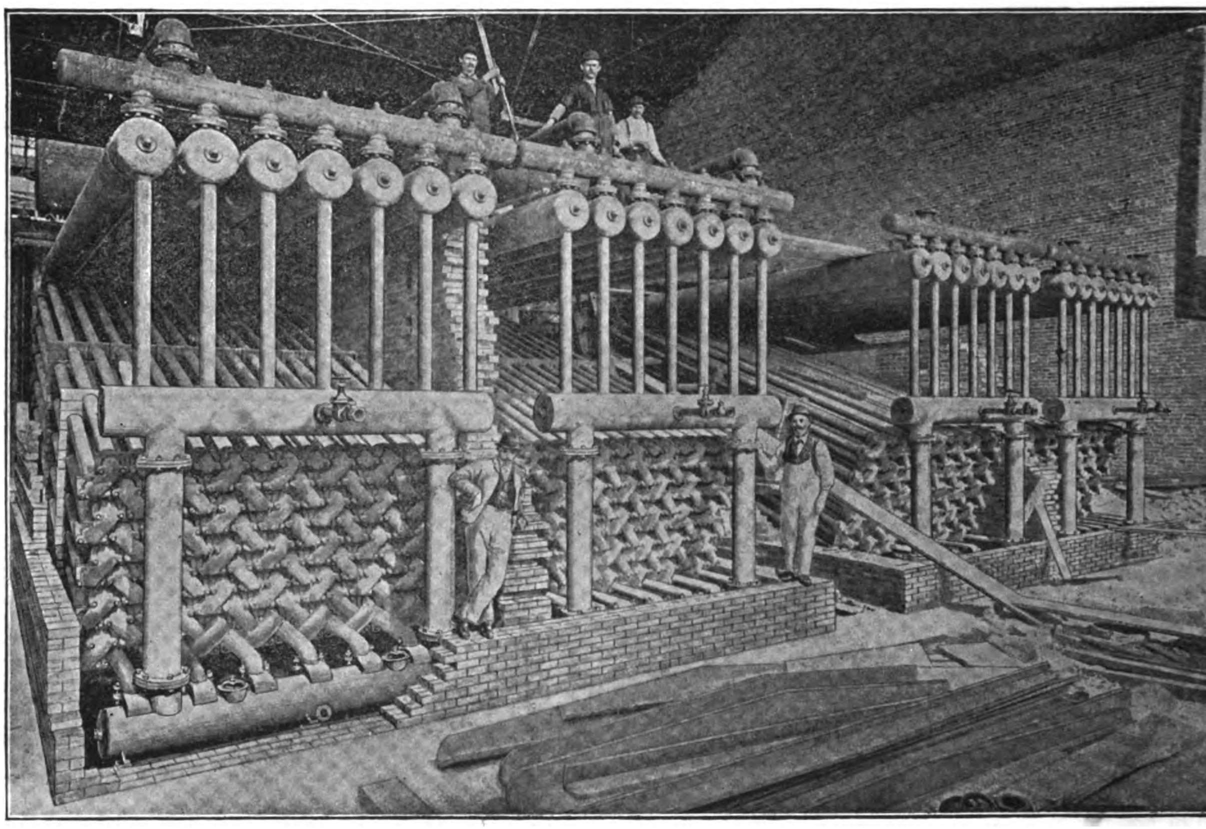


FIG. 2.—SETTING A BATTERY OF ROOT BOILERS.

A PAIR OF ELECTROSTATIC VOLTMETERS.[1]

BY H. S. CARHART.

IT is often desirable to be able to measure directly the potential difference between the primary wires of an alternator without recourse to a transformer or other auxiliary device. An electrostatic instrument is especially applicable to this purpose since it has no self-induction and takes no current. Such an instrument for laboratory purposes, which has proved exceedingly satisfactory, I have had made by my mechanician, Mr. Ralph Miller.

But another one capable of measuring from about 20 or 25 volts up to 100 is needed for the purpose of calibrating the first. This I have also designed and Mr. Miller has built with much skill.

Both of these instruments may very properly be called electrostatic dynamometers. Each contains a mirror from which a beam of light from a lamp is reflected to a fixed scale; and in using them the spot of light is brought back to the initial or zero position, by turning the torsion head before the reading is taken. The beam of light, some 40 inches in length, takes the place of the pointer of a Siemens dynamometer. In this particular I have followed Mr. Swinburne, but in most other respects the design differs from his. In fact I had never seen a Swinburne voltmeter till after my first instrument was made, and my second one differs from his more than the first.

Refering to Fig. 1, which consists of a horizontal and a vertical section, it will be seen that the fixed portions of the electrical device consist of four half-circular flat boxes, 3 inches in diameter and ½ inch deep inside. The lower pair are supported on ebonite pillars, and the upper ones are supported from the lower by means of lead glass rods set into appropriate sockets. The needle consists of two half circles of very thin aluminum mounted on wire of the same metal, as shown in the small diagram in the lower left-hand corner of the figure. It is evident that when the half circles are cross-connected, as shown, and one pair of inductors is connected with the needle, the forces acting on the movable system are all such as to turn it in one direction. The needle is suspended by a phosphor-bronze wire about 0.0015 inch in diameter

1. Abstract of a Paper read before the International Electrical Congress, Chicago, Aug. 21-25, 1893.

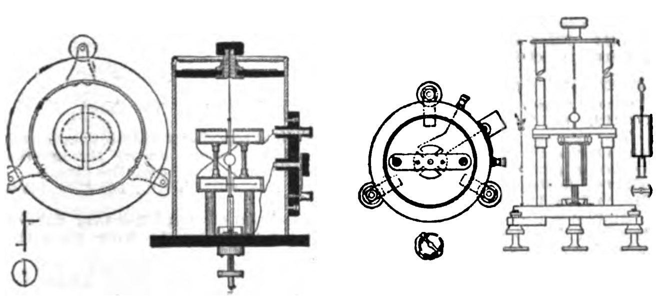
from a torsion head of brass with a hard rubber top. The hole through this brass head is larger than the drawing shows except at its upper end; so that the suspending wire is perfectly free except at its point of support. Below, the axle of the needle is connected by means of a spiral of platinum-silver wire to the brass cup containing paraffin oil as a damper. The mirror hangs midway between the two half circles forming the needle.

The scale, resting on the hard rubber at the top, is divided into 400 equal divisions, and the pointer is set to the zero of this scale after the adjustment has been made. Connections with the mains are made by means of the rubber covered binding posts as shown, and the key which is drawn in the charging position, is made to discharge the quadrants or inductors by turning through 180°. The damper consists of a horizontal disc, supported by two wires from the axis of the needle, and having at its centre a hole through which passes the pin holding the spiral.

When the instrument is charged, the system swings, twisting both the supporting wire and the steadying spiral at the bottom. This spiral has more torsion than the wire. The torsion head is turned till the spot of light returns to zero, and the twist of the suspending wire is then read by the pointer on the scale. The instrument is practically deadbeat and its performance is in every way most satisfactory.

Since the instrument is used idiostatically, the calibration curve should be a parabola. It departs from a parabola only very slightly. One thousand volts were measured by a twist of the suspending wire of about two and a quarter turns. No appreciable set was observed. This same instrument has been used with success to obtain the curve of primary E. M. F. of the alternator, no other apparatus being required except the usual contact maker on the end of the dynamo shaft. The readings may be taken very quickly and conveniently.

The second instrument is shown in section in Fig. 2, the case



FIGS. 1 AND 2.—A PAIR OF ELECTOSTATIC VOLTMETERS.

being omitted. The sectors are cylindrical and are supported on a hard rubber head, which in turn is rigidly attached to a strap of hard rubber supported on two brass columns. These carry the divided scale at the top. The hard rubber head is slotted, as shown at the left, to increase insulation between the cylindrical sectors. The needle consists of two cylindrical sectors shown at the right. The damper is made in the same way as in the first instrument. The entire suspended system in this case is aluminum, except the spiral at the bottom, which consists of a very thin phosphor-bronze strip, made by rolling on a mandrel, annealing and finally retempering. The suspension is made by means of a quartz fibre. A much finer fibre than the one used would carry the system which weighs a little over one gramme. This instrument is much more accessible for adjustments than the other, since the brass case can be removed without disturbing any of the parts. The cylindrical sectors are only an inch in diameter, the vertical adjustments are effected by sliding the supporting sleeves up or down on the posts, and the leveling screws are made so as to secure the instrument to the shelf on which it stands.

ELECTRIC POWER TRANSMISSION FOR NEUCHATEL, SWITZERLAND.

THE communities of Neuchatel, Loche and La Chaux-de-Fonds, in Switzerland, are about to carry out a comprehensive water power project looking to the utilization of the waters of the River Reuss for the generation and distribution of electric power for general power and lighting purposes. The project provides for damming the river and carrying the water through an artificial channel to a large storage and distributing reservoir at Combe Garrot, immediately above the site chosen for the station. The head of water made available in this way will be about 300 feet, and the channel to be built is to have a capacity of about 177 cubic feet per second. The normal flow of the river, however, is considerably less than this, averaging about 106 cubic feet per second, while the minimum flow does not amount to more than about 60 cubic feet per second. It is, however, rarely the case that the river reaches this low point.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPTEMBER 12, 1893.

Alarms and Signals:—

Electric Door Register for Watchman, W. R. Patterson, Chicago, Ill., 504,741. Filed Jan. 31, 1889.

Electric Signal Device, C. R. Piggins, Racine, Wis., 504,745. Filed April 4, 1893.

An electric signaling device for letter boxes.

Electric Signal Device, C. H. Rudd, Evanston, Ill., 504,758. Filed Dec. 10, 1888.

Provides means for automatically indicating accidental grounds.

Electric Mechanical Gong, F. M. Dunn, Baltimore, Md., 504,887. Filed June 23, 1892.

Electrical Alarm System, C. K. Hall and W. B. Lillard, New Orleans, La. 504,980. Filed Nov. 2, 1892.

An automatic burglar alarm system.

Conductors, Conduits and Insulators:—

Automatic Safety Joint for Electric Conductors, J. H. Curry, Wilkinsburg, Pa., 505,083. Filed Nov. 13, 1892.

Distribution:—

Electric Switchboard, F. W. Mount, St. John, Canada, 504,738. Filed April 5, 1893.

An arc switchboard designed to switch the terminals of the dynamo wires with the terminals of the circuit wires by means of cross rods off-set at their intersections and connected by plugs.

Dynamos and Motors:—

Commutator Brush Holder, R. N. Baylis, New York, N. Y., 504,901. Filed March 30, 1894.

An interchangeable holder to be used with either carbon or metallic brushes.

Multiphase Motor, L. Bell, Boston, Mass., 504,904. Filed Nov. 4, 1892.

Employs a closed circuited secondary member forming the revolving part of the motor and carrying current impeding devices for reducing the primary current flowing in the secondary incident to starting the motor, and means for removing the impeding devices from circuit when the proper speed has been attained.

Dynamo Electric Machine, R. Eldredge, New York, N. Y., 504,914. Filed May 13, 1891.

Employs a revolving disc armature, two opposite circular ranges of field magnets and adjusting devices for changing the relative positions of the ranges.

Galvanic and Thermo-Electric Batteries:—

Galvanic Dry Battery, J. Von Der Poppenburg, Charlottenburg, Germany, 504,746. Filed Oct. 11, 1892.

The carbon electrode is soaked in a solution of hydroxide of chrome.

Lamps and Appurtenances:—

Socket for Incandescent Lamps, C. G. Perkins, Hartford, Conn., 504,748. Filed July 10, 1891.

Has for its object to provide means for preventing the detachment of the parts of couplings by reason of shocks, to which they are liable.

Electric Arc Lamp, C. T. Snedeker, Worcester, Mass., 504,760. Filed March 20, 1893.

An arc lamp holder so constructed that the insulated wire connected with the lower carbon shall be protected from the heat generated by the arc.

Carbon for Electric Arc Lamps, R. McManus, Brooklyn, N. Y., 504,815. Filed Oct. 27, 1892.

A pair of carbon pencils comprising coke and mineral oil in their composition, the one having a core of lime and the other a core of plumbago.

Carbon for Electric Arc Lamps, R. McManus, Brooklyn, N. Y., 504,845. Filed July 8, 1892.

Consists of a composition of coke, mineral oil and iron coated with iron.

Electric Light Fixture, F. W. Davenport, Providence, R. I., 504,866. Filed July 22, 1893.

An adjustable fixture for desks, tables, etc. (See THE ELECTRICAL ENGINEER, Aug. 27.)

Electric Arc Lamp, W. B. Luce, Brookline, Mass., 505,051. Filed Dec. 5, 1892.

Relates to the construction of the clutch mechanism and of the globe holder.

Portable Electric Lamp Support, N. T. Mills, Boston, Mass., 504,060. Filed Oct. 15, 1892.

Measurement:—

Electric Measuring Apparatus, C. H. Rudd, Evanston, Ill., 504,754. Filed Oct. 19, 1891.

An apparatus for the measurement of insulation resistance designed especially with a view to portability.

Miscellaneous:—

Electrolytic Diaphragm, A. Breuer, Iserlohn, Ger., 504,708. Filed Jan. 4, 1892.

An electrolytic diaphragm composed of a cement that will set or harden at normal temperatures when combined with a suitable liquid in due proportions, and of a porous substance capable of resisting the action of an electrolyte, as comminuted pumice stone, combined with and distributed throughout the body of cement.

Lighting Attachment for Gas Burners, N. Marshall, Boston, Mass., 504,785. Filed Nov. 25, 1892.

Portable Static Electric Machine, T. H. Patee, Chicago, Ill., 504,740. Filed Dec. 9, 1892.

Electrical Testing Apparatus, C. H. Rudd, Evanston, Ill., 504,751. Filed Jan. 14, 1888.

An apparatus for testing for grounds on circuits by means of the telephone.

Electrical Testing Apparatus, C. H. Rudd, Evanston, Ill., 504,753. Filed Feb. 8, 1889.

Similar in its object to 504,752.

Electrolytic Cell, T. Craney, Bay City, Mich., 504,774. Filed Feb. 13, 1893.

Railways and Appliances:—

Trolley Head, J. P. Maddox, Westbrook, Maine, 504,731. Filed Oct 7, 1892.

An arrangement for allowing the trolley to move from side to side while the pole remains comparatively rigid.

Conduit Electric Railway, H. D. Older, Paterson, N. J., 504,847 Filed Aug. 23, 1892.

Consist of a wooden bottom and curved wooden sides between the upper edges of which is a slot, and a metal covering for the conduit having flanges at its lower edges by means of which it is fixed to the ties.

Supply System for Electric Railways, G. F. Green, Kalamazoo, Mich., 504,977. Filed Feb. 13, 1893.

Employs stationary contact devices adapted to successively make contact with the circuits on the car.

Conduit Electric Railway, C. O. Ehlert, New York, N. Y., 505,061. Filed Aug. 23, 1892.

Relates to guides and special construction of the contact devices within the conduit.

Switches and Cut-Outs:—

Electric Cut-Out, H. N. Prentice, Stowmarket, Eng., 504,988. Filed May 31, 1893.

An automatic cut-out operated by variation in magnetic attractions due to an abnormal condition of the circuit.

Switch for Governing Electric Motors, E. F. Ramien, Milwaukee, Wis., 505,063. Filed April 8, 1893.

Designed to obviate the necessity of employing any outside resistance.

Switch for Controlling Electric Motors, H. Sawyer, Muskegon, Mich., 505,064. Filed Feb. 20, 1893.

Relates to the employment of motors in situations permitting very limited movement in either direction and is designed to guard against overrunning.

Telegraph:—

Printing Telegraph, S. R. Linville, Philadelphia, Pa., and L. F. Hetmansperger, Camden, N. J., 504,782. Filed Dec. 16, 1892.

A printing telegraph provided with subscribers' instruments, printing and type wheel circuits in parallel to earth at the instrument, and a central station with devices for controlling the pole changer and alternator.

Telephones and Apparatus:—

Restoring System for Annunciators, L. A. Berthon, Paris, France, 504,797. Filed May 17, 1893.

A device for automatically operating the indicator shutters on a telephone switchboard.

Telephone Transmitter, J. A. Brown, Moline, Ill., 504,801. Filed Apr. 25, 1893.

Employs two grained surfaced electrodes at right angles to each other and normally in contact, adapted to be actuated by the vibration of the diaphragm.

Telephone Switch, J. Steiner, Brooklyn, N. Y., 505,070. Filed Oct. 19, 1891.

Consists of a rod journaled at one or more points and adapted to rotate and provided with a hook supporting the telephone receiver and yieldingly held in a horizontal position by means of a spring.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPTEMBER 19, 1893.

Accumulators:—

Process of Manufacturing Electrodes, C. Pollak, Frankfort-on-the-Main, Germany, 505,125. Filed April 19, 1893.

Consists in mixing pulverized carbonate of lead with caustic soda or caustic potash to form a paste and then forming the paste into a suitable shape, drying it, and placing it in an alkaline bath, applying an electric current to reduce the carbonate of lead to metallic lead and then compressing the whole while in a wet state.

Alarms and Signals:—

Block Signal Apparatus, J. H. Frischen, Berlin, Germany, 505,419. Filed April 18, 1893.

An electric block signal system for steam railways.

Block Signal Apparatus, J. H. Frischen, Berlin, Germany, 505,420. Filed May 18, 1893.

Similar to 505,419.

Conductors, Conduits and Insulators:—

Insulator Pin, J. J. O'Neill, Boston, Mass., 505,128. Filed April 14, 1893.

Consists of a non-metallic portion and a re-enforcing metal portion.

Machine for Covering Wires, J. A. Barrett, Brooklyn, N. Y., 505,379. Filed March 29, 1892.

Machine for Covering Wires, J. A. Barrett, Brooklyn, N. Y., 505,380. Filed Oct. 27, 1892.

Dynamos and Motors:—

Dynamo Electric Machine, A. S. Atwater, Cleveland, Ohio, 505,184. Filed Jan. 16, 1893.

Claim:

In a dynamo machine, the combination of a ventilated armature, a single coarse wire coil about the armature having its terminals in collecting rings upon the main shaft, a shunt field exciting coil connecting the terminals of the coarse wire coil and the sections of a duplex commutator, a field circuit having its terminals in radial brushes engaging the said sections and a rheostat in said field circuit provided with an automatic cut-out whereby the rheostat is cut out of the circuit until a normal current has been generated.

Automatic Regulator for Dynamo Electric Machines, O. P. Philbrick, Somerville, Mass., 505,207. Filed April 2, 1892.

Provides means by which the commutator automatically changes its position with relation to the brushes while the latter remain stationary.

Armature for Dynamo Electric Machines or Motors, W. T. Kosinski, New York, N. Y., 505,247. Filed May 5, 1893.

Consists of a plurality of separate laminated cores to which the coils are applied before the armature is entirely assembled.

Electric Motor, E. R. Esmond, New York, N. Y., 505,396. Filed Aug. 15, 1893.

A motor in which both the field and the armature are rotatable and are combined with an intermediate pinion by which they are geared together.

Galvanic and Thermo-Electric Batteries:—

Electric Primary Battery, T. Coad, London, Eng., 505,392. Filed Nov. 10, 1892.

The invention relates to the form and connections of the cell and its plates.

Lamps and Appurtenances:—

Electric Light Fixture, B. F. Flint, Cincinnati, Ohio, 505,097. Filed June 17, 1893.

Intended for signs, show windows, etc.

Revolving Electric Light, B. F. Flint, Cincinnati, O., 505,098. Filed July 5, 1893.

A display fixture similar in its object to 505,097.

Electric Arc Lamp, A. S. Atwater, Cleveland, O., 505,183. Filed Jan. 16, 1893.

Employs flat carbon plates having linear edges presented to one another to form the arc, a stationary holder for the lower carbon and an oscillating holder for the upper carbon.

Electric Arc Lamp, A. Schmid, Chicago, Ill., 505,233. Filed Jan. 10, 1893.

Employs a mechanical trip feed device and a separate mechanical time control device co-acting at predetermined intervals to release the trip feed device.

Electric Lighting System, A. G. Waterhouse, Hartford, Conn., 505,241. Filed Nov. 28, 1892.

Employs an automatic rheostat actuated by both the magnetic forces of the current which passes through the lamps and the current of a derived circuit which spans the path upon which the lamps are placed.

Electric Headlight, E. A. Edwards, Cincinnati, O., 505,351. Filed Aug. 15, 1893.

Electric Arc Lamp, S. Bergmann, New York, N. Y., 505,283. Filed July 19, 1893.

Employs a vertically movable frame and a switch rod arranged to be operated thereby in its movement and a vertically and laterally movable switch lever insulated and included in the shunt circuit of the feeding magnets.

Electric Lamp Socket, J. M. Gardner, Jr., Pittsburgh, Pa., 505,422. Filed July 1, 1893.

Claim 1 follows:

A socket for electric lamps, having an ejector arranged to force the lamp from the socket when required.

Measurement:—

Recording Voltmeter, W. H. Bristol, Hoboken, N. J., 505,248. Filed April 17, 1893.

Employs a stationary solenoid, a movable solenoid with metallic portions on its opposite sides insulated from each other and forming the terminals of the solenoid, and flexible supports in electrical connection with the metallic portions of the solenoid.

Miscellaneous:—

Lightning Rod, N. D. C. Hodges, Plainfield, N. J., 505,106. Filed Dec. 17, 1890.

Claim 1 follows:

A lightning rod provided with one or more deflagrating sections adapted to be destroyed by the passage of a discharge of lightning.

Cleat for Holding a Plurality of Insulated Electric Wires, E. W. Buffington, Fall River, Mass., 505,215. Filed March 27, 1893.

A cleat formed of two parts, one having grooves in which the wires are placed and the other having a series of V-shaped grooves extending at right angles to the wires and holding them securely in place.

Electric Door Operating Apparatus, O. H. Hicks and R. F. Troy, Chicago, Ill., 505,270. Filed May 15, 1893.

An automatic device for opening and closing doors (See THE ELECTRICAL ENGINEER, Sept. 20, 1893.)

Electric Door Operating Apparatus, O. H. Hicks and R. F. Troy, Chicago, Ill., 505,271. Filed May 15, 1893.

Similar to 505,270.

Electric Illuminated Sign, H. A. Bierley, Lexington, Ky., 505,346. Filed Feb. 8, 1893.

Electro-Medical Air Injector, J. Dawdy and F. M. Cattern, Denver, Colo., 505,398. Filed Aug. 7, 1893.

Balloon for Observing Distant Objects, C. A. Smith, San Francisco, Cal., 505,414. Filed May 11, 1893.

Carries electric lights and reflectors.

Railways and Appliances:—

Current Conveyer for Electric Railways, W. Lawrence, New York, N. Y., 505,204. Filed June 27, 1893.

The contact plate formed of two parts held together within insulation by an outer casing in such a manner that should the casing be worn through the the lower part of the plate will fall away and avoid grounding the circuit.

Electric Railway Trolley, E. R. Robinson, Nashville, Tenn., 505,370. Filed March 7, 1893.

Employs a centrally grooved tread and broad supplementary flanged treads at the sides of the grooved tread for receiving the wire when the wheel's axis is not at right angles thereto.

Telephones and Apparatus:—

Telephone, J. B. S. Booth and E. J. Falconer, Manchester, Eng., 505,087. Filed Jan. 31, 1893.

Employs a single diaphragm between and perpendicular to two coaxial pole pieces of a permanent or electromagnet; the pole pieces having coils included in the line circuit having a tendency to produce similar polarity in the ends of the pole pieces next to the diaphragm.

Telephone Switch, T. W. Ness, Montreal, Can., 505,170. Filed May 22, 1893.

An independent switch key and telephone mechanism with means whereby the key is, after being moved to the several points of the keyboard by hand, automatically returned to its normal condition.

Multiple Switchboard Apparatus, J. J. Carty, New York, N. Y., 505,188. Filed Feb. 2, 1889.

Consists in means for automatically grounding the cut-off portion of telephone lines when the lines are connected, dispensing with test circuits and simplifying the apparatus.

Telephone System, W. W. Davis, California, Mo., 505,306. Filed Dec. 30, 1892.

A system of telephony in which a single line wire connects a number of different instruments.

FAST TELEGRAPHING IN BOSTON.

A REMARKABLE record in telegraphic annals, both for speed and accuracy, was made at the main office of the Postal Telegraph Company in Boston recently. Assistant manager Bagley sent 58 messages in the unprecedented time of 30 minutes. The messages were those of ordinary character, such as occur in the regular daily transmission of business, and averaged 10 words in the body, exclusive of the address and signature. This would be faster average time than that made by Gibson, the champion fast sender at the tournament held in New York last fall, when that lightning sender sent 97 messages in an hour.

In the latest trial the address was abbreviated, but the body of the message was spelled out in full.

It will be seen that at this rate of speed, Mr. Bagley was sending at a rate that would dispose of 116 messages in an hour.

THE ELECTRICAL DEVELOPMENT COMPANY.

THE ELECTRICAL DEVELOPMENT COMPANY has been placed in the hands of Charles Batchelor as receiver. The company was organized in 1890 for the purpose of constructing street railways, but it is understood to have practically gone out of business as a construction company. Its assets, consisting of stocks in other companies have depreciated in value owing to the great shrinkage of values, and its inability to provide money to pay its debts, made a receivership necessary. The suit in which the receiver was appointed was brought by John I. Beggs, a stockholder.

MR. PENNOCK'S COMPLIMENTS AND OURS.

A COUPLE of weeks ago we made casual reference to the means whereby Mr. G. B. Pennock is enticing dollars out of the pockets of good citizens of Bridgeport and the vicinity. He is "promoting" his "invention" which enables him to furnish from 100 to 1,000 incandescent lights at a total cost of three cents per hour! Our little exposure of Mr. Pennock was followed by a long and windy attack on THE ELECTRICAL ENGINEER by that gentleman in the columns of the *Bridgeport Farmer*, from which we are glad to learn, by the admission of his "superintendent," Mr. J. Johnson, that the electrical papers "have kept lots of capital out of the Pennocks." That is just what we are aiming at, since the man is slick enough to deceive many people if his little game were not shown up.

Mr. Pennock says in his interview in the *Bridgeport Farmer:* "If I am a fakir, then so were Newton, Howe, Ericsson, Morse and tens of thousands of other workers to whose inventive genius and to whose achievements the civilization of to-day owes an inestimable debt of gratitude. I may never rank with some of the men I have named, but I contend that my motives are as pure as theirs, while my ambition is as high."

We have received a letter from Mr. Pennock, which we print below, *verb et lit*, as affording a striking and brilliant picture of the man.

BRIDGEPORT, Conn. Sept 21 1893

Editor (?) of the Electrical Engineer (?)

I have just read the "roast" your "fake" sheet of the 20th gives me.

I wish you would give my compliments to the so-called Electrical Engineer who claims that he had a "long talk" with me and tell him that he is either a dam' liar or a dam' fool. The man who wrote the article for your "rot" is a dam' dirty thief.

Send your "Gang" up and you'll meet a few honest men who will take great pleasure in "knocking out" a few of the damnest rotten thieves—Dynamo Editors and dynamo Sharps—who ever scuttled ship or cut a woman's throat.

I am Sir
Your Superior,
Geo B Pennock
Electrical Engineer & Inventor
of the Pennock systems.

We quote the following from the *Bridgeport Daily Union* of Sept. 26:

HE SCORES PENNOCK.

PEORIA EDITOR ON THE INVENTOR—REPLY OF THE ELECTRIC MAN.

[Special to the Daily UNION.]

PEORIA, Ill., Sept. 25.—Give Pennock a wide berth. He worked this city as well as one or two others. He tried for over a year to move a car and failed, He has failed everywhere. He is a good talker and smooth worker. Look out.

J. B. BARNES,
Editor Journal.

When shown the dispatch Mr. Pennock became very angry and said: "That man Barnes I know well. He is a personal enemy of mine. The car he speaks of I run successfully for over a month, which made the dynamo men very jealous. Barnes is in league with them and is trying to injure me in every city I go."

Mr. Pennock is very badly used, and in order to cap our own brutality towards him we respectfully invite the attention of the "honest men" of the State of Connecticut and the city of Bridgeport to the presence of Mr. G. B. Pennock, as an electrical "crook" who has plundered the innocent for several years; and we hope they will keep their good money in their pockets.

LITERATURE.

The Dynamo. Its Theory, Design and Manufacture. By C. C. Hawkins and F. Wallis. *New York*, D. Van Nostrand Co. *London*, Whittaker & Co. Cloth, 8vo. 520 pages. 190 Illus. Price, $3.

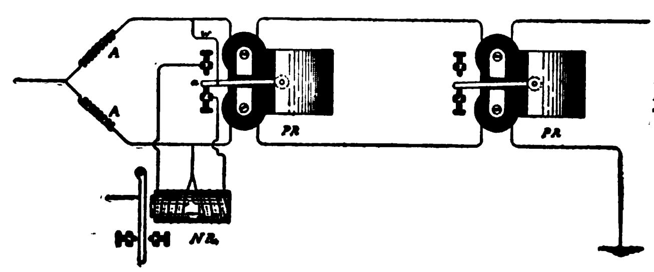
THIS is an admirable book, presenting its subject matter very comprehensively, written with much skill and intelligence, embodying the observation and experience of dynamo builders who have expressed their ideas and opinions, and carrying the reader through by easy, natural stages of development and advance from the simple elements and forms of a coil cutting the lines for a field of force, up to the latest and best types of apparatus known to the art. The arrangement is excellent, the illustrations are new and helpful, and the index is most careful and thorough. It is possible to make a treatment of the dynamo very tiresome, for the ground has often been traversed and where one writer goes the next is apt to follow; but in the present instance the handling is quite attractive, and the analysis from first to last is such as to assist the student and engineer very materially in securing information that really informs. Moreover, while nothing essential has been omitted, the authors have stuck to their text. They have also wisely limited themselves in submitting as examples only a few of the leading machines as types; and have kindly avoided conducting us through a chamber of horrors in the shape of fantastic abortive creations, or through a museum of antiquities, in the shape of dynamos long since obsolete. There must be a historical and philosophical consideration of the subject, and this we have in Prof. S. P. Thompson's masterly encyclopœdic work; but as an every-day, workaday manual the present volume is entitled to the highest praise. It deserves, and will enjoy, hosts of readers.

LETTERS TO THE EDITOR.

MR. MAVER ONCE MORE ON THE WICKS ARRANGEMENT.

IN THE ELECTRICAL ENGINEER of September 13th last, I notice Mr. Grandy's comments upon the Wicks arrangement, briefly described in my article on "The Moment of Reversal in the Quadruplex," in the issue of August 16th, 1893. In the course of his comments, Mr. Grandy takes occasion to dispute the correctness of my view that the Wicks arrangement "avoids entirely the moment of reversal in the neutral relay." Nevertheless I still hold that view. Mr. Grandy also questions the statement that the arrangement can be made a successful working one, he having proved to his own satisfaction by his own experiments and theorizing that it cannot be and ought not to be. The fact that the arrangement has been in successful operation for months denotes something astray with Mr. Grandy's experiments.

Mr. Grandy has apparently proceeded on the assumption that the use of an extra polarized relay and a neutral relay in the bridge wire, both having exactly equal self-induction, is compulsory. It would appear self-evident that if the arrangement is to operate successfully as described, the relative self-induction and general construction of the two relays should be suitably proportioned to that end, and it is a little singular that the results of Mr. Grandy's own experiments did not suggest this to him. Still, it may be said that a superficial consideration of the subject could lead to the conclusion reached by Mr. Grandy, and it is possible that one might become so engrossed with the importance of what one supposed was an original and conclusive discovery as to suspend further thought. On this and other points a short



WICKS QUADRUPLEX ARRANGEMENT.

quotation from the specifications of the letters patent covering the Wicks arrangement may be of interest. I shall change the letters of reference to accord with those of the diagram accompanying my article and reproduced here.

"At the moment of reversal, if the action of P R[1] (extra polar relay) were slow in moving armature lever *a*, a reverse current would flow through that coil of relay N R last in action, and the object of my invention would be defeated. I find, however, that under ordinary conditions no such reversals in the coils of relay N R occur, although it might well be assumed that before armature lever *a* could be moved from its contact point enough current of opposite polarity would flow through the coil to reverse the magnetic polarity of its core. The action of *a* is so quick, however, that the mechanical effect of the reverse flow could be but slight, but if the tendency were greater it would ordinarily be dissipated by the self-induction of the relay itself. And in some cases it may be desirable to so construct relay N R that it shall have considerable self-inductive capacity or lag, but such remedy should be sparingly applied as the effect of self-induction is to render relays slow and inefficient as telegraphic receiving instruments."

As regards placing the contact of the neutral relay on the front stop and thus dispensing with the repeating sounder, as Mr. Grandy implies should be done, I am not aware that it has been stated that it would be so dispensed with. The fact that there is likely to be a moment of diminished current in the neutral relay of the Wicks arrangement was distinctly mentioned, and this would tend naturally to diminish or vary the pressure at the local contact points of that relay, if on the front stop, to a greater or less extent, depending on the self-inductive effect of the relay at that moment. But there could be a wide difference as regards the variation of the magnetism of the relay, between that due to a momentarily diminished current in one direction and that due to an entire cessation of current. Apart, also, from the question of the "moment of reversal" there are well-known reasons for retaining the contact on the back stop of the neutral relay.

With reference to Mr. Stephen D. Field's remarks in last week's ELECTRICAL ENGINEER, I would say that if the so-called bug in the quadruplex is not attributable to the reversal of magnetism in the neutral relay, that reversal would at least appear to afford a sufficient explanation for its existence. It is somewhat difficult to accept Mr. Field's explanation as to the part played by the equating condenser, in face of the fact, for instance, that on a quadruplex circuit having for the line wire, as well as for the artificial wire, a rheostat, and in the absence of an equating condenser, the defect is still quite perceptible.

I, however, fully agree with Mr. Field that additional apparatus

should not be employed in any device or system unless it is conclusively shown that the increased efficiency obtained thereby is considerably greater than such additional apparatus.

WM. MAVER, JR.

NEW YORK CITY, Sept. 20, 1893.

PERSONAL.

MR. ERNST EGGER, son of one the leading electrical manufacturers of Austria, has just returned to Vienna, after a long stay in this country, where he has devoted himself to a complete mastery of American dynamo construction and central station practice. His last duty here was to represent the electrical society of Austria at the Electrical Congress. The acquaintance with this intelligent and highly trained young Austrian has been a great source of pleasure to his numerous American friends, who hope that some day he may favor this country with another visit of equal length.

A NEW APPARATUS FOR PROJECTION.

BY OSCAR KNIPE.

ALTHOUGH the advantages of screen projection for illustration of lectures and scientific experiments have been generally admitted, and the projector has been introduced in very many classrooms, the full extent of its usefulness for scientific projection could not until recently be realized, because the oxy-hydrogen light is not powerful enough, and the electric arc lamps were not perfect enough to obtain a steady light and satisfactory results. Within the last two years, however, a new style of electric arc lamp has appeared, and one of its principal recommendations is that it is adapted to a low potential (that is, the incandescent current) insuring perfect immunity from electric shock and an absolutely steady and continuous light. Every expert will be delighted to learn that he can let his electric light take care of itself so that he may devote all his attention to his lecture or experiments, as the case may be.

The object of this paper is to describe a new apparatus, known as the "Paragon," Fig. 1, which the writer has employed for nearly two years in projection with the microscope, the polariscope, etc., with unparalleled success. This new projector differs essentially from all former apparatus in construction. Advantage has been taken of the style of arc lamp to completely separate the optical system from the light. Here we have a complete slide base with a number of carriers disposed upon it similar to an optical bench, and by this arrangement the various lenses or other accessories can be located as desired and the whole set can be placed at the proper distance from the light without interfering with its adjustment. A set of three differential condensing lenses, mounted in cells separately, enable the operator to select the most suitable for any special experiment to obtain the best results in illumination, as well as in definition; this is not possible with the old style combined double or triple condenser fixed in the lantern.

For the projection of scenes and diagrams the "Paragon" is furnished with a special achromatic objective, supplemented with the patent multifocal lens; this lens placed behind the objective diminishes its magnifying power without interfering with its definition, so that the distance from the screen can be doubled and yet produce a picture of half the size that the objective alone would give.

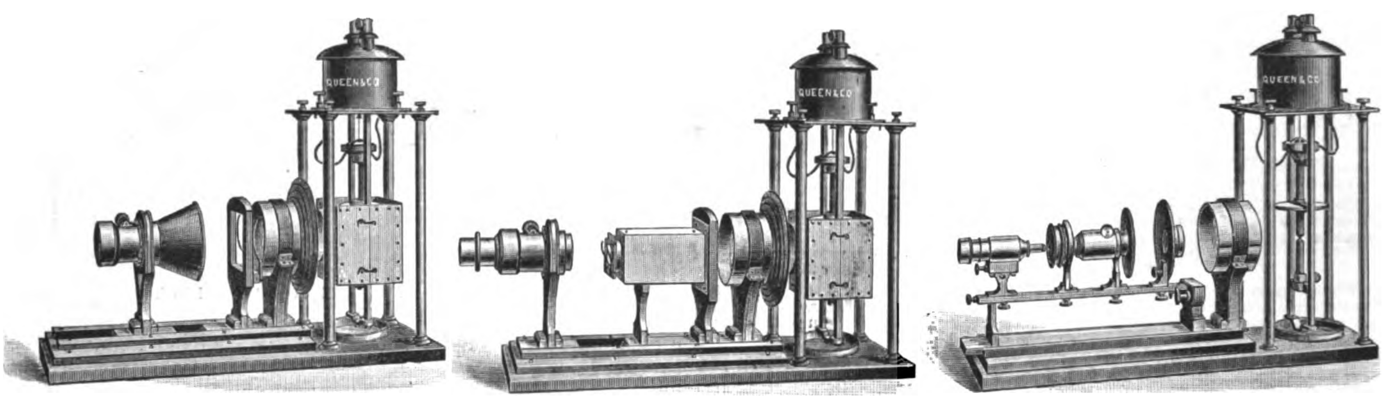
This constitutes the "Paragon" projector for illustrating lectures on history, geography, etc., by views and diagrams; but its principal distinction consists in the accessories, which are really the most important part of a scientific projector, and here we discover at once the advantages of the optical bench.

The polariscope, Fig. 2, is composed of a pile of thin glass plates for the polarizer mounted on a slide stand and provided with an object-holder which can be rotated. It is easily adjusted to the light so that the refracted ray enters the analyzer and crosses at its centre. If desired, a silvered mirror can be attached over the pile to intercept the reflected ray, which may then be projected simultaneously with the refracted one and thus produce two images.

The analyzer is a 20 millimetre Nicol prism mounted on a rotating cell which is fitted in the objective. A complete disc of polarized light can be projected alternating light and dark with the rotary motion of the analyzer. Among the objects suitable for this instrument may be named geometrical designs of mica and calcite; chilled glass shapes (*verre trempe*); chemical preparations; crystallization of acids while in progress.

The polariscope is also supplemented by a combination of converging and dispersing lenses for the purpose of exhibiting the colored rings and crosses in crystals in general; for special scientific investigation in crystalography; the necessary graduated circles and verniers, goniometer, etc., can easily be added to complete it.

The projection microscope is shown in Fig. 3. Its distinguishing feature is found in the application of an achromatic negative lens to convert the converging rays coming through the condensing lens into a cylinder passing to the secondary condenser. These are provided with rack and pinion, so that the illumination of the object can be adjusted with great nicety. Not only is the silvery whiteness of the arc light a great advantage, but as the radiant is comparatively a point, the definition given by a good objective is superb. Abundant light is at hand to obtain a power of 1,000 to 3,000 diameters with perfect definition. A flea, for example, may be enlarged to 15 feet in length.



FIGS. 1, 2 AND 3.—"PARAGON" APPARATUS FOR PROJECTION.

REPORTS OF COMPANIES.

REGULAR WESTERN UNION DIVIDEND DECLARED.

THE directors of the Western Union Telegraph Company have declared the regular quarterly dividend of 1¼ per cent. The statement presented is more favorable than was anticipated; it shows that at the close of the quarter ended June 30, 1893, there was a surplus of $6,888,457, of which (on account of sundry fractional and other items aggregating 16.38 shares) there has since been capitalized by the issue of additional stock $1,638, making the total capital stock outstanding $94,820,000 and reducing the surplus on July 1, to $6,886,819.

The net revenue for the quarter ending September 30, part of August and all September being estimated, is put at $1,800,000. The falling off for the quarter is about $400,000. This will give $8,686,819, from which there must be deducted $223,346 for interest on bonds and $20,000 for the sinking fund, leaving $8,443,473 applicable to dividends. It requires for a dividend of 1¼ per cent. on the capital stock issued, $1,185,000, deducting which leaves a surplus of $7,258,473.

HARTFORD, CONN.—Articles of association of the Capitol Electric Company of Hartford have been filed in the secretary of state's office. The company is formed for the buying, selling and dealing in all kinds of electric supplies. The capital stock is $20,000. E. C. Wilcox, F. R. Faxon and J. P. Tuttle are the directors of the company.

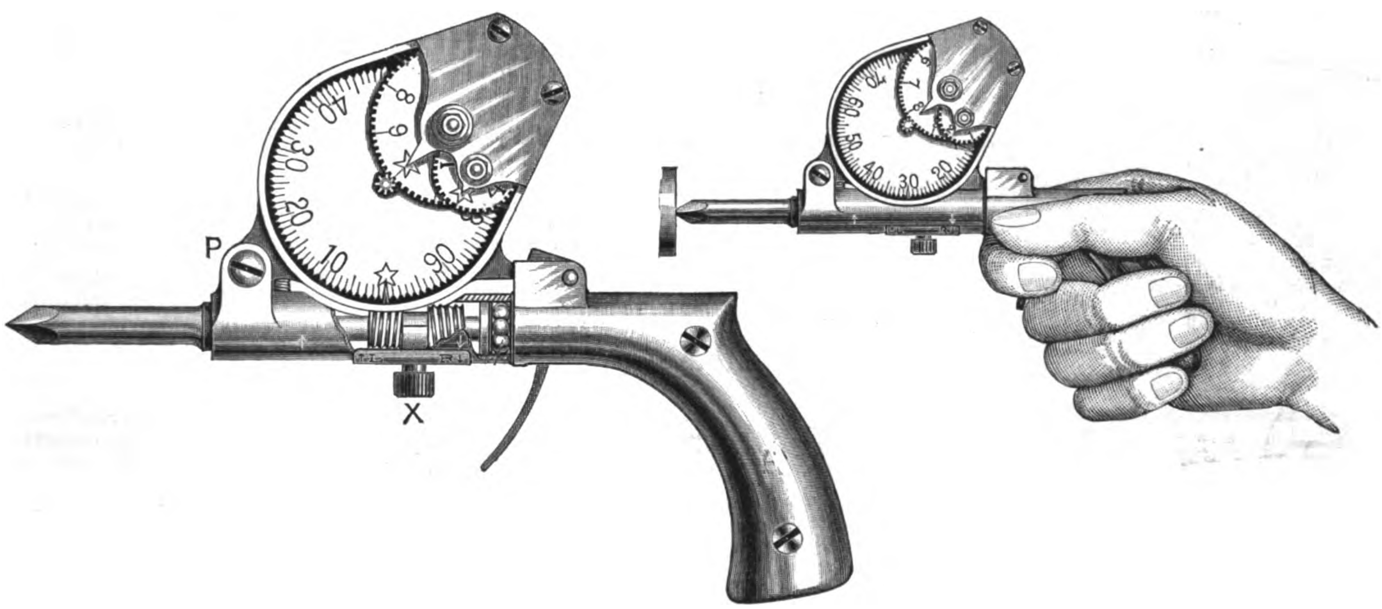
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PARAGON SPEED INDICATOR.

THE accompanying illustration represents the Paragon speed indicator made by Lintner & Sporborg, Gloversville, N. Y. In Fig. 1, a portion of the bearing in which the spindle revolves is cut away to show the worm gear connections, and also to illustrate the ball bearing at the inner end of the spindle, designed to sustain the end thrust when the device is in use. The handle is of pistol grip form; the spindle has its outer end angularly pointed and its inner end provided with a ball bearing. The frame in which the dial-wheels are mounted is pivotted to the stock at P so that it can be moved downward against the force of a spring, to cause the teeth of the dial-wheel to engage with one of the worm gears on the spindle. The dial-wheel which meshes into the worm gear is graduated to indicate units and tens of revolutions. This dial-wheel has a pinion which meshes with a dial-wheel indicating hundreds, which in turn actuates another dial-wheel indicating thousands of revolutions. This "thousands" dial is very useful in connection with such high-speed machinery such as dynamos, motors, etc.

The dials can be easily and quickly reset to their normal positions at zero by turning a thumb-nut at the back of the dial frame until the star on each dial-wheel is opposite its respective pointer. The shifter slide, X, carries with it the two worms, one right-hand and the other left-hand, which, though mounted to rotate with the spindle have a sliding movement controlled by the shifter. This shifter may be pulled to the right or left according to the direction in which the shaft is running, as indicated by the letters on the slide, revolving the dial-wheels always in the same direction, and avoiding confusion in reading the result by having only one set of figures.



FIGS. 1 AND 2.—PARAGON SPEED INDICATOR.

By pulling the trigger lever, the dial-wheels are brought into operation. The pistol-grip is claimed to be the steadiest and securest form of handle ever devised.

Fig. 2 illustrates the way the indicator is held in the hand and the manner in which it is pressed against a shaft. This pressure, though slight, is sufficient to cause the spindle to revolve with the shaft, but has no effect upon the dials until they are brought into engagement.

The watch is held in the other hand and at the moment the second-hand reaches a convenient point and the shaft is running at its normal speed the trigger is pressed and the registering mechanism instantly brought into action. When the second-hand has completed its circuit, the trigger may be released, and instantaneously disengages the registering mechanism even though the spindle continues to revolve. An accurate registration is in this way obtained without so much as looking at the instrument after it is once applied until after it has been removed.

The device is the invention of Mr. William T. Lintner, of Gloversville, N. Y., and is patented in this country and all over Europe. Mr. Lintner has long been associated with the Wheeler & Wilson Manufacturing Company and has an enviable record both as a business man and an inventor.

THE IMPERIAL FRICTION CLUTCH.

"EVERYONE knows it pays to use friction clutches. They afford instant control over machinery, countershafts and line-shafts. They make the power in each room independent. They are equally good for heavy or light service, for high speed or low speed. They operate instantly or gradually, just as you wish. They avoid accidents and delays. They dispense with loose pulleys and shifting of belts. They save belting, bearings, shafting, power, time and dollars. No wonder the best equipped factories, nowadays, plan to use them and won't have anything else."

With this peroration, Messrs. J. W. Penfield & Son, of Willoughby, Ohio, open a little treatise on friction clutches in general, and, in particular, the "Imperial," manufactured by them and claimed to possess several points of unquestioned superiority. The pamphlet in which these claims are set forth is tastefully gotten up and well illustrated with views of the clutch in question.

MASON VACUUM VALVE.

A NOVELTY in the way of a regulating device is the Mason vacuum valve, recently manufactured by the Mason Regulator Company, of Boston, at the request of a large Canadian sugar refinery, which has now several in use. It is to the regulation of a vacuum, what the reducing valve is to steam pressure, for by placing one of these valves in the exhaust pipe leading to the vacuum pump, any desired amount of vacuum may be kept in the chamber, by simply adjusting the valve.

It is especially desirable where different degrees of vacuum are desired in each one of a series of chambers, as in the triple effect process of sugar refining, and other processes where a certain vacuum is desirable.

UNION ELECTRIC LIGHT AND POWER COMPANY.

IN February last a consolidation was effected between the Waterford Electric Light and Power Company, of Waterford, N. Y., and the Union Electric Light and Power Company, of Lansingburgh, N. Y., whereby the management of both plants came under the care of one company, known as the Union Electric Light and Power Company of Lansingburgh and Waterford. On July 1 this company bought out the Green Island, N. Y., Electric Light Company and is now operating all three plants. The officers are: Wm. M. Lea, Lansingburgh, president; J. Stanford Brown, New York, general manager; H. W. Hamblin, superintendent.

THOMSON ELECTRIC WELDING COMPANY.

THE AMERICAN PROJECTILE COMPANY, one of the healthiest of the sub-organizations, has been consolidated with the parent Thomson Electric Welding Company. It has made already about $800,000 worth of shell for the Government, and has very large contracts under negotiation. The new company will be called the Thomson Electric Welding and Projectile Company, and will have a capital stock of $1,000,000, half common, half preferred 7 per cent.

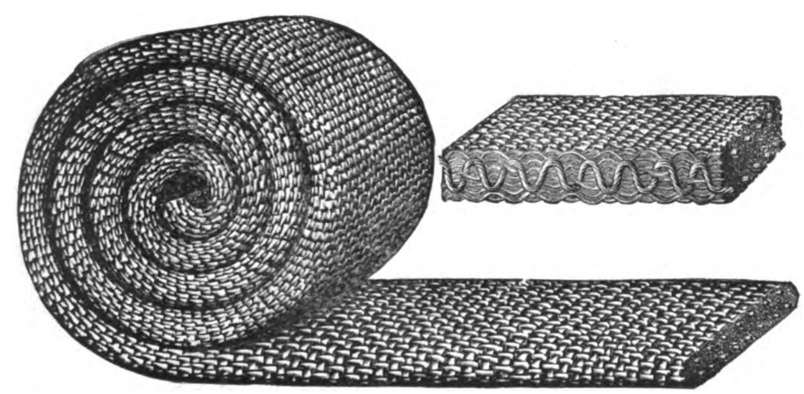
KERITE.

YEARS ago, when most of us were young, Prof. Morse spoke in high praise of "Kerite," and the repute of that insulation has gone on growing and spreading ever since. That after all the trial of time and the test of competition it still remains worthy of the highest praise and approval is shown in the award just made at Chicago, where the judges echo the encomiums of the Father of Telegraphy and set the seal of triumph of to-day on the verdict of the past. Mr. Brixey is certainly to be congratulated. His share in the success and present prominence of "Kerite" has not been a small one, and under his vigorous management, "Kerite" will go on conquering and to conquer.

MADDOX COTTON AND WIRE BELT.

THE accompanying illustration shows a section of belting made by the Maddox Wire Belt Co., the general agent for which is H. N. Green, 1,219 to 1,229 Filbert street, Philadelphia.

This belting is made of cabled soft steel wire and cotton, woven solid together, and is claimed to be the strongest, most durable and lasting, and the most powerful belting made. The cables are each composed of six soft steel wires, twisted together and laid lengthwise in the belting, about one-eighth of an inch apart, forming about one-half of the warp, the rest of the belt being composed of strong, tough cotton yarn, spun especially for this belting. The weaving of the cotton and wire solidly together, completely covers the wires so that the wire cables do not come in contact with the pulleys at all and the wire cannot be seen in the belting except when it is cut so as to expose it. The rough surface given to the belting by the cotton also forms an elastic, rough face that prevents any air cushions forming between the belt and pulley.



MADDOX COTTON AND WIRE BELT.

A SCHOOL OF APPLIED ELECTRICITY.

PROF. E. P. ROBERTS and Mr. L. B. LeVake, of Cleveland, Ohio, announce an interesting and promising undertaking, namely, a School of Applied Eectricity on a somewhat novel plan. They propose to employ three methods of teaching, I, entirely by correspondence; II, tuition by correspondence and personal examinations, and III, personal attendance at the school and a portion of the tuition by correspondence. Prof. Roberts will be president of the school and Mr. LeVake will be secretary. They will have the services of competent assistants and consulting experts. Requests to lecture before local engineering societies suggested to Prof. Roberts the outline of his plans for the school—the idea of combining the method of correspondence—now for a long time successfully employed in many branches of study—with personal attendance and examinations, seems a very felicitous one for electrical instruction, affording means of sound and thorough-going tuition not only to beginners who are unable to attend regular school courses at points distant from their homes, but as well to the large number of men already engaged in electrical work who desire further technical training but cannot leave their duties to attend a school or college electrical course. The attainments and experience of both the gentlemen named are ample to guarantee the quality and soundness of the instruction to be expected. Professor Roberts, since his graduation at Stevens in 1877, has had an experience of unusual variety, all in connection with electrical and mechanical engineering; including work as a draughtsman, teaching mechanical drawing, superintending a machine shop, assisting Mr. Maxim, and afterwards Mr. Weston, in the laboratory of the United States Electric Lighting Company; serving as superintendent and general manager of an electric light company, superintendent of a gas company, associate professor of electrical engineering at Cornell University, and general manager of the Swan Lamp Company. During the past year he has had a consulting office at Cleveland, which he expects to continue. Professor Roberts was elected secretary of Section C (Pure Practice), at the recent Electrical Congress Mr. LeVake has been long known in electrical circles through his important position in the Brush Electric Company.

NATIONAL SOCIETY OF ELECTRO-THERAPEUTICS.

THE NATIONAL SOCIETY OF ELECTRO-THERAPEUTICS held its first annual meeting at the Berkeley Lyceum, in West Forty-fourth street last week. The sessions were held during the morning, afternoon and evening, and were attended by prominent electro-therapeutists from this and neighboring cities. The society has a membership of 105. A majority of the members participated.

NEW YORK NOTES.

NEFTEL, O'CONNOR & CO., INCOR.—Mr. Chas W. Marsh, having retired from the Neftel & Marsh Co., Mr. B. F. O'Connor, formerly of Columbia College has connected himself with a new company of the above name at 126 Liberty street, New York. The officers are: Knight Neftel, president; B. F. O'Connor, treasurer; J. Stanford Brown, secretary. It is not generally known that this change was made about July 1st.

THE ATLANTIC ELECTRIC MANUFACTURING CO., of Brooklyn, has been formed to sell and manufacture electrical apparatus. It has a capital of $100,000. Directors: Warren P. Freeman, Albert T. Schlichting, Julius Smith, all of Brooklyn.

THE ELECTRIC EXPERIMENTAL & DEVELOPING CO., has been formed in this city with a capital stock of $100,000. The directors are W. E. Mandelick, W. B. Vandewater and A. G. Mackandrew of New York.

MESSRS. WM. C. CALLMANN & CO., of 136 Liberty street, this city, and 679 Broad street, Newark, N. J., report large sales in the Phenix incandescent lamp from all parts of the country.

THE CONSUMERS' ELECTRICAL SUPPLY CO., capital $1,000, has been formed in this city by H. G. Martin, E. Brussel and Julian A. Moses.

PHILADELPHIA NOTES.

MR. CHAS. RUSSELL, who for some time past has carried on an electric construction business at 18 So. Broad street, has closed his establishment and entered the employ of the Cutter Electric and Manufacturing Company.

MR. F. A. LA ROCHE, president of the La Roche Electric Works, left for Chicago on Friday to open an office in that city. He will also spend some time at the World's Fair.

THE LA ROCHE ELECTRIC WORKS have opened a branch office at 516 Liberty street, Pittsburgh, Pa., which will be in charge of Messrs. Rigby & Fowler.

DR. W. A. DRYSDALE is preparing plans and specifications for a 2,300 light plant for the State Hospital for the Insane at Norristown, Pa.

NEW ENGLAND NOTES.

MESSRS. A & J. M. ANDERSON, of 21 Hamilton street, Boston, Mass., manufacturers of the "Aetna" railway supplies, in announcing the opening of their new factory at 289-293 A street, Boston, October 1st, say they will there be thoroughly equipped with the best modern tools and appliances for the manufacture of their products in larger quantities to meet the ever-increasing demand for them. They will be enabled to make prompt shipments and will maintain the high standard for which their specialties have gained popularity.

WESTERN NOTES.

PITTSBURGH, PA.—The Pittsburgh Electric Club has gone into the hands of a receiver.

TOLEDO, OHIO.—Steps are being taken for the formation of an electrical society.

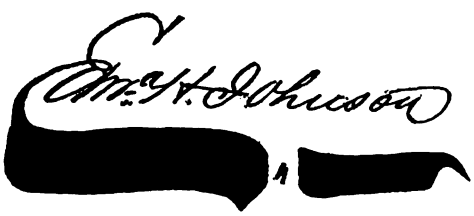
☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. OCTOBER 11, 1893. No. 284.

SUPERFICIAL CRITICISM ON THE "TROLLEY."

BY



A LEADING New York paper has called attention to the fact that approximately a million dollars is being demanded as compensating damages for injuries and death inflicted by the Brooklyn electric cars alone.

It is observed that this abnormal destruction has affrighted the insurance corporations which have heretofore guaranteed against this sort of risk, and their protection is, in consequence, withdrawn, leaving the burden of loss directly with the nominally responsible authors.

It is but fair to assume that independent of all moral consideration this pecuniary liability is greatly exercising the minds of the railway officials ; it is also but within the bounds of common justice and humanity to assume that the motorman is keenly alive to the ever-present liability to do mortal injury to his fellows, and yet we have so great an educational force as the *New York Tribune*, making editorially such superficial observations as that the fault lies primarily with the false economy of the railway authorities, and, secondarily, with the limited intelligence or moral turpitude of the motorman.

Furthermore much stress is frequently put upon the trolley, the electric current, etc., as though therein specifically danger resided, whereas, it is well established that the trolley wires and the electric current they carry are practically harmless ; the injuries inflicted are due almost exclusively to the mere fact of self-propulsion. Were any other power employed to propel the car, independent of horses, the result would be the same if *subject to no better control.* The qualification is important, as it is therein we shall accurately and justly locate the responsibility and mayhap discover the remedy for the evil.

In examining the newspaper accounts of these so-called trolley accidents, we find such expressions as these :

"A test of the car showed that it was unmanageable and could not be stopped within a block."

"The car got out of the motorman's control."

"The motorman of the rear car stuck to his post in his endeavor to keep the car under control."

"Suddenly the brakes became unmanageable and the heavy car began to descend with perilous speed."

"The motorman was unable to stop his car in time to avoid a collision," etc., etc.

An analysis of the fifteen fatal accidents reported in August, disclosed the pregnant and pertinent fact that in eleven of them it was proved that the motorman could not manage the car, and, in the case of the other four, the evidence was in favor of the assumption that an efficient brake would have prevented fatalities. A most conspicuous illustration is afforded by the Cincinnati accident, resulting in the loss of several lives and the more or less permanent maiming of a score or more of the passengers. "The brakes failed to work," and the car was free to descend a mile-long heavy grade, of course with constantly augmenting velocity. But it is idle to multiply facts in illustration, every daily reader is already conversant with the refrain.

Clearly the fault is not with the railway company nor yet with the motorman, but rather is due to inherent deficiency of the apparatus by which the car is propelled. Were that what it should be, the very power employed to propel the car could and would be called into requisition to overcome its impetus as in a steam locomotive. Why is it not ? This is the essence of the inquiry and to its satisfaction should be directed discussion and criticism, rather than, as now, to the chastisement of the helpless and innocent railway official and employé.

Electricity is the greatest force in nature and, moreover, the most subordinate to control. The electric motor *is* reversible. Why then have we not in an electrically propelled car the effective and safe power to arrest its momentum and avoid accidents ? The answer is, *imperfect application.* In that answer too, is to be found the reason for the failure of all attempts to apply electricity to the elevated roads. Thus we locate the responsibility for the shortcomings of the electric motor with the inventor, not, be it noted, with the electric inventor, but rather with the mechanician, for as an electrical apparatus the motor is perfect. Its mechanical application is, however, faulty. Evidence of this fact and of its appreciation is abundantly afforded by the Patent Office record, teeming as it does with patents on methods of gearing the motor to the axle. A close analysis thereof will disclose a common purpose, viz., to so apply the electric motor as to permit it to obey its natural impulse to *rapid* and *instantaneous* action. Both these, be it noted, are the mortal foes of inertia and momentum, whereas the fundamental requisite of economical and safe railway duty is *time* in which to overcome inertia and arrest momentum. In view of this attestation of recognized deficiencies and of corrective work, is not the practical question one of competent inquiry into merits ? How and by whom shall this inquiry be made ? Is it safe to rely upon the supposition that competing manufactures will promptly secure and adopt innovations, perhaps involving expensive departures in manufacturing and consequent interference with profits ? Have the electric manufacturing corporations been so conducted as to warrant the assumption that they will go counter to past experience and is not that experience replete with tardiness, rather than promptness, in this respect ? In short, is not the present crying evil directly chargeable to the disposition of the great manufacturers to "let well enough alone ?" Shall we have the answer affirmatively in the form of more perfect apparatus or negatively in the form of argument ?

THE HEAT OF DIELECTRIC POLARIZATION.

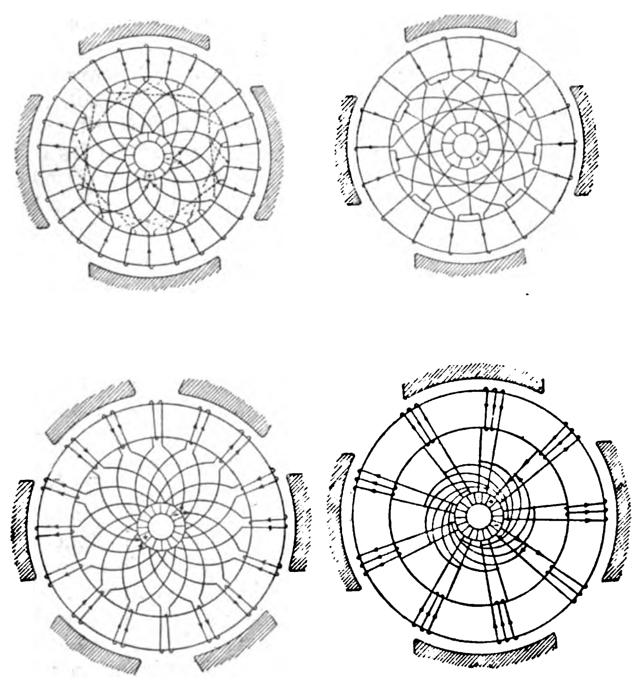
In a recent Paper by A. Kleiner, entitled "Ueber die durch elektrische Polarisation erzeugte Wärme," says the London *Electrical Review*, an investigation of the heat produced in insulators by dielectric polarization is described. A plane condenser, formed of a plate of the substance under examination, and provided with a tin armature on each of its faces, was submitted to a rapid succession of charges and discharges. The elevation of

temperature was measured by means of a small thermo-electric couple soldered to one of the armatures. Experiments were carried out with mica, gutta-percha, glass, paraffin, ebonite, wax and caoutchouc; and in every case the elevation of temperature produced by the same number of charges was shown to be inversely proportional to the square of the thickness of the plates employed. Kleiner deduces that the quantity of heat produced by each charge is proportional to the square of the quantity of electricity brought into play, or, in other words, the energy developed in the armatures. Other things being equal, the absolute value of this quantity of heat varies from one dielectric to another, but always remains almost of the same order of magnitude.

ARMATURE WINDING FOR HIGH TENSION MULTIPOLAR MACHINES.

BY W. R.

In the August 23 issue of your valuable journal there is a note on an alleged new armature winding of L. Baumgardt which is claimed to be specially adapted for 4-pole high tension machines. The winding in question, however, is by no means new, for it corresponds exactly with Fig. 51 of the book entitled "Die Ankerwickelungen der Gleichstrom-Dynamomaschinen," by E. Arnold (Berlin, Julius Springer, 1891). The accompanying engraving, Fig. 1, shows a ring winding scheme for 4-poles and 26 coils, devised by E. Arnold. Each coil in the engraving is represented by a single turn, while Mr. L. Baumgardt employs two turns to represent each coil. The number of commutator segments in both cases is equal to half the number of armature coils.



FIGS. 1, 2, 3 AND 4.

Fig. 2, taken from the same book, is a variation of this method for 4 poles and 18 coils. Instead of placing the coils which are joined in a single pair in magnetic fields of opposite polarity, as in Fig. 1, the adjacent coils in this case are joined in one pair.

Besides this, in the book mentioned, two additional armature windings are given which are very well adapted for large direct current machines. Fig. 3 represents a 6-pole ring winding with 16 coils in which the latter are wound according to the wave system in series with one another. The number of commutator segments is here equal to the number of coils. This is probably the simplest and best series winding for multipolar ring armatures. The cross-connection of the coils can be arranged in two separate planes so that they occupy small space and good insulation can be obtained.

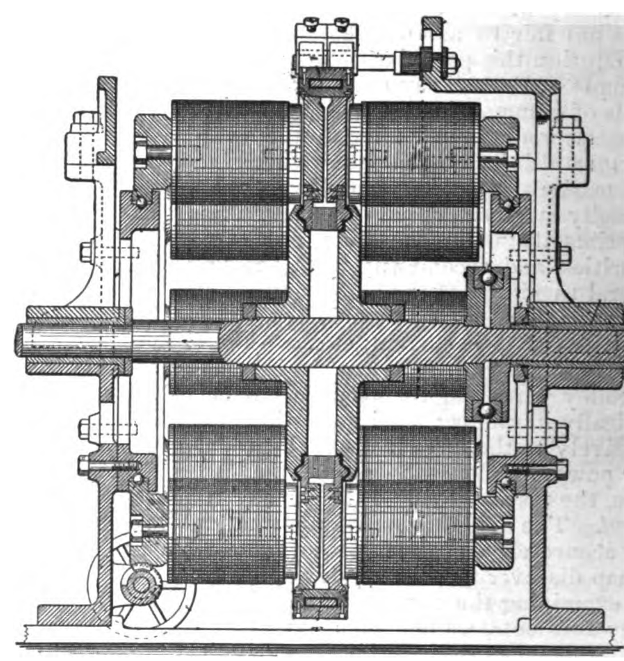
Fig. 4 represents a special ring winding devised by E. Arnold, in which the number of the commutator segments is equal to twice the number of the coils. The beginning and ending of each coil are connected to adjacent commutator segments and the cross connections which can be placed within the commutator are so arranged that no crossing takes place. This method of ring winding has also proved itself valuable in many instances.

In conclusion it may be remarked that in the book above mentioned, reference is also made to the applicability of the wave winding for parallel connection, the carrying out of this winding depending only on the proper selection of the number of coils and their spacing.

THE ELDREDGE DYNAMO.

MR. ROLFE ELDREDGE, of this city has recently designed a form of generator shown in vertical section in the accompanying illustration.

The armature bars are made in two ranges or layers on the radial lines and are connected up in such a manner that the current passes through the bars of the armature from one commutator brush to the other. By this arrangement the magnetic resistance of the inter-polar space is reduced by the soft iron of the armature, and the inventor dispenses with the wires usually employed in armatures and lessens the risk of injury by burning out, as the bars are of larger sectional area than the external conductors, and by this construction, no core being needed, Foucault currents are avoided. In arranging the field magnets, the polarity alternates and the south of one range is opposite the north of the other range when the dynamo is running at its full capacity, but these circular ranges are variable in the position of one in relation to that of the other or to the brushes, so that the energy of the field magnets on the armature, and the current set up, can be lessened to any desired extent by a movement given to one or both ranges to bring the pole pieces toward the place where the respective polarities will coincide.



ELDREDGE DYNAMO.

WORLD'S FAIR DEPARTMENT.

THE WESTERN ELECTRIC COMPANY AT THE WORLD'S FAIR.—I.

I.

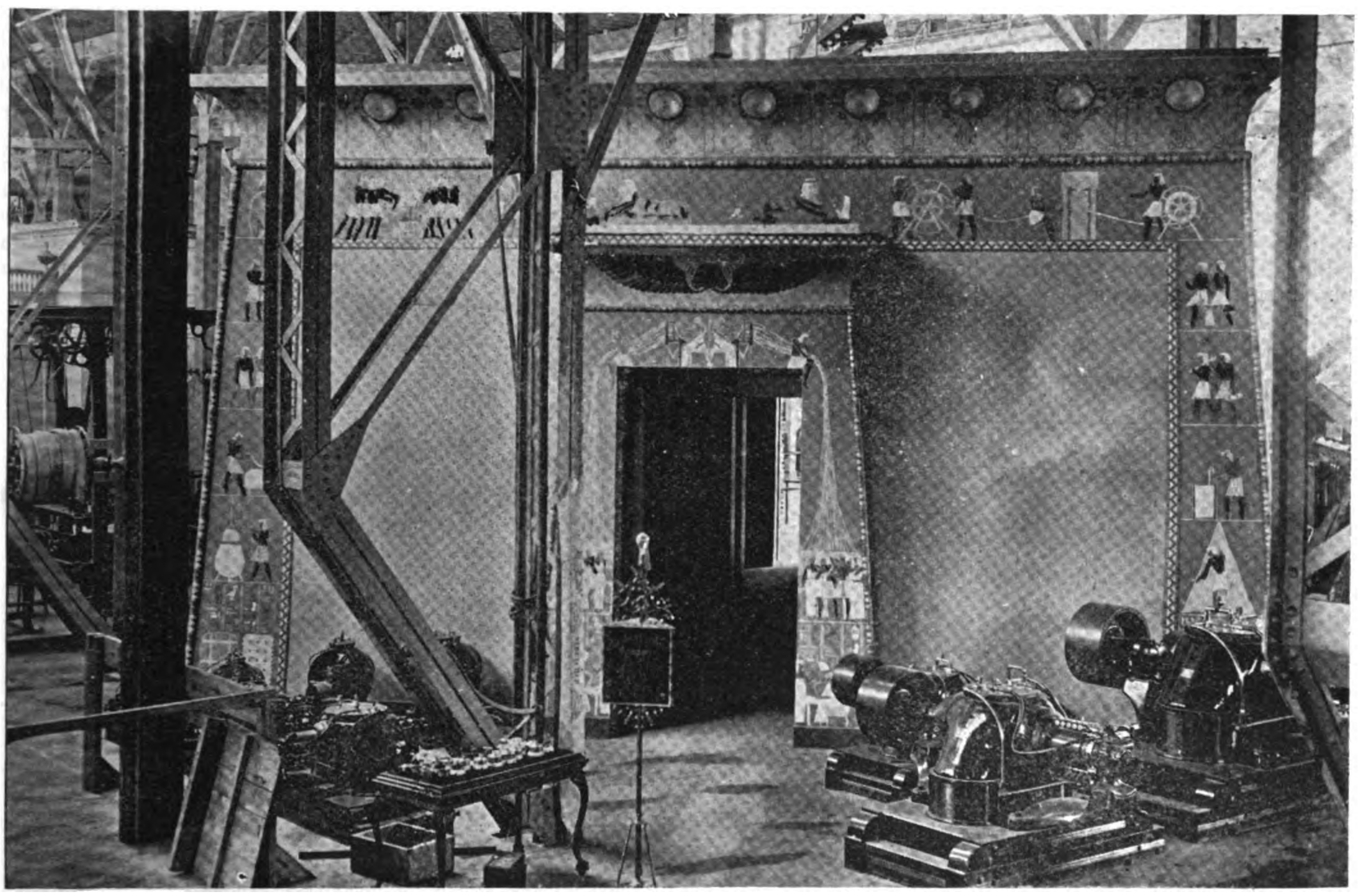
EXHIBITIONS in general may be divided into two classes, namely, technical and popular; each of these has its particular merits, but in an exhibition such as the one at Chicago, the best results are undoubtedly obtained by a judicious combination of both the above types, rather than by exclusive adherence to either one.

In arranging its exhibit at the World's Fair, therefore, the Western Electric Co., essayed to afford the technical public not only a complete idea of the large, varied character of the products of its factories, but, in addition, to present it in such a manner as would make the exhibit easy of inspection, while at the same time making it so attractive that the lay visitor also would find himself interested in what would otherwise be passed unnoticed by him. It is safe to say that in both these respects the company has succeeded admirably and its exhibit probably attracts as many visitors, if not more, than any other in Electricity Building. The exhibit, taken collectively, represents examples of work in probably every branch of applied electricity, ranging from a push button to a dynamo, and including electric light, telegraph, telephone and kindred apparatus, the mere enumeration of which would require considerable space. It can be safely said that no other electrical exhibit in the entire Exposition presents such a variety of products manufactured by one concern, and indeed there is probably only one other firm in the whole world, the variety of whose products equals that of the Western Electric Company.

The space assigned to the company is at the right of the main entrance of the building facing the Administration plaza and covers an area of 110 x 110 feet. In addition to this the electric scenic theatre operated by the company in an adjoining space covers an additional area of 22 x 60 feet. The diagram on page 318, shows clearly the manner in which the space is laid out and the location of the various types of apparatus.

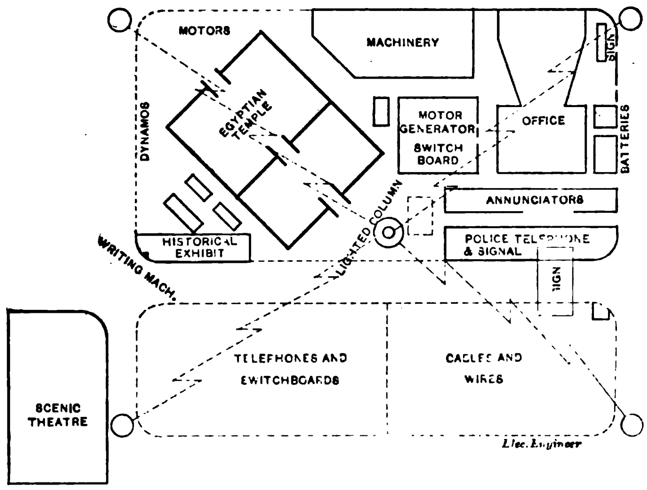
In order to make the inspection of their smaller work, such as telegraphic apparatus and fine instruments as easy as possible, the company erected within their space a structure in imitation of an Egyptian temple, shown on this page, beautifully ornamented, and thoroughly lighted on the inside. In this temple the apparatus is displayed in frames let into the side walls and covered with glass. In these frames are shown the various types of telegraph sounders and transmitters, the engraving on page 318, representing the standard Steiner sounder. The levers of these sounders and transmitters are made of hard drawn brass tubing which gives them excellent acoustic properties. Here are also shown cable lightning arresters consisting of two metal plates separated by an air space of $\frac{5}{1000}$ inch; the Western Union standard switchboard, double pen registers and discharge keys.

In another frame we find various galvanometers and Wheatstone bridges, rheostats and also the stenograph and



THE EGYPTIAN TEMPLE, CONTAINING TELEGRAPH, ELECTRICAL MEASURING AND OTHER SMALL APPARATUS.

the Edison electric pen, which is shown in its various parts; both of these instruments are manufactured by the Western Electric Co. Demonstrating the great variety of work shown by the company, is a board upon which are mounted



Arrangement of the Western Electric Co.'s Exhibit.

not less than 2,000 different punchings of brass, of every conceivable shape. Passing around still further, the visitor has presented before him the various telephone sets and what are known as mill magnets for extracting iron from grain. In another case are various sizes of dynamo comb switches, the clips of which consist of a series of copper strips. Close beside this case is another with call boxes for district messenger service with from 4 to 11 calls. In another case are switches for incandescent circuits ranging from a capacity of 20 to 1,000 amperes; also ammeters of the type illustrated on this page, ranging from 10 to 1,500 amperes and voltmeters from 120 to 500 volts. Electric bells are also shown in great variety as well as push buttons, of which no less than 24 different types and styles are exhibited. Among these we note one with a spun metal top which acts as a diaphragm and carries the button. Being hermetically closed, the entrance of dust and moisture is prevented and the contacts as well as the wire connections preserved.

Besides the exhibit shown in the Egyptian temple the cases in the section devoted to telegraphs and switchboards contain a large variety of telephone transmitters and magnets made both at the works of the company in Chicago and in New York as well as in Antwerp, Belgium.

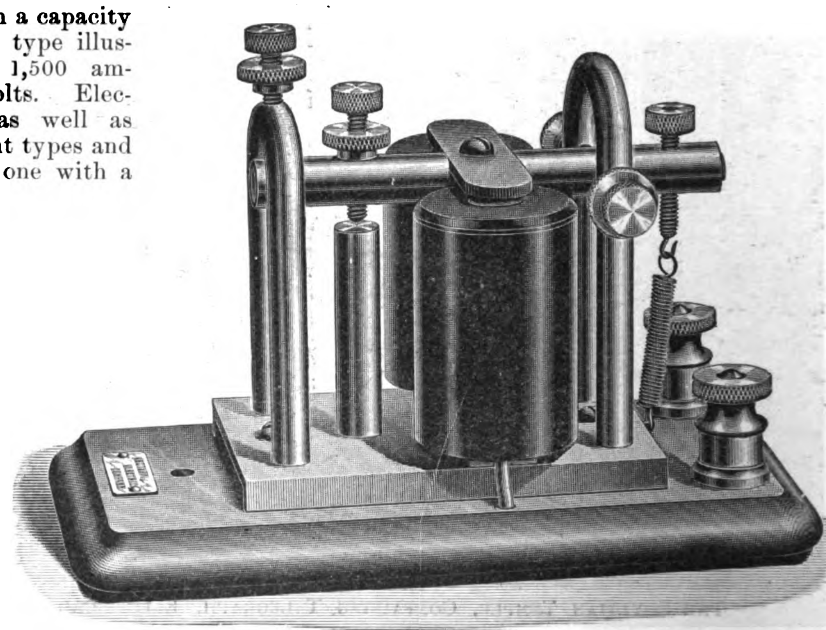
II.

Among the earliest, if not the very earliest, in this country to take up the systematic manufacture of telephone switchboards, was the Western Electric Company. The visitor to the Fair would therefore expect to find within the company's exhibit, a good exposé of the state of the art, and in this he will not be disappointed. The arrangement of the exhibit is such, however, that it not only shows the present development of the telephone switchboard, but traces its progress from the first form of multiple board which was used in actual practice in this country.

The engraving on page 320 shows the first type of multiple board, designed in 1884 and exhibited in the switchboard space. This board is of the double cord pattern, with the cords overhead, and has large jacks and large annunciators, and with it only 1,500 lines can be handled, and even then the operator has to reach very far, so that frequently two operators had to be put on each section; then again the operator could only ring the subscriber's bell to which her telephone, for the time being, was connected. In later boards, provision has been made so that the operator can call the subscriber on any one of the several lines, while she is listening or taking calls from a subscriber on any other line. There are listening keys on the 1884 board, but only one set of ringing keys for each operator, instead of a set for each pair of cords which she handles. The diagram on page 319 shows the circuit connections of this board. The next improvement made, is exemplified in what is termed the "1887" board. This was a single cord board, the lines all ending in separate cords. In order to operate it, all that is necessary is to pick up a plug and insert it in the line called for, whereas in the 1884 board it was necessary to handle two plugs; it is also provided with a calling key for every subscriber. But, nevertheless, it had the disadvantage that the operator was obliged to pick up a certain telephone cord, and, in addition, the connection had to be made complete at the board where the call originated, which was a decided drawback on holidays, when there was only a small force in attendance at the exchange When the cord broke, as frequently happened, the subscriber's service was interrupted until the repairs could be made, which was also a source of annoyance; hence, though an improvement over the former type, it still involved disadvantages. The arrangement of the board will be readily understood from the diagram of circuits, page 319. In a board subsequently made, the same principle was adopted as in the board of 1884, but with the cords at the bottom of the board, instead of at the top; the calling keys could handle 3,000 subscribers.

Another board, known as the "Hog Trough," was the

The Western Electric Ammeter.



The Steiner Telegraph Sounder.

next one designed, and is exhibited; it is capable of handling 4,800 subscribers. The annunciators and calling keys are nearly on a level, and in this board, the new annunciator with tubular drop, was introduced. This drop consists of a tubular electromagnet with a core constituting one pole of the magnet while the tube constituted the other pole. In the old forms of annunciator, the magnets frequently acted inductively on each other, and conversation between one line and a neighboring one, could be overheard, The tubular form completely shields the magnetism, and makes this impossible. There is also shown in this place, a board intended for places where the number of subscribers is not likely to grow beyond one thousand, and which is illustrated on this page.

The engraving on page 323 shows the new "Branch Terminal" board, and represents the one erected in the temple of the American Bell Telephone Co., adjoining the exhibit of the Western Electric Co., by whom it was manufactured. This board serves as the exchange for the entire Exposition, and as such, affords the public an opportunity of witnessing and studying all the details of the most modern type of telephone exchange apparatus. The distributing board which occupies a space immediately to the left of the main switchboard, takes the cables as

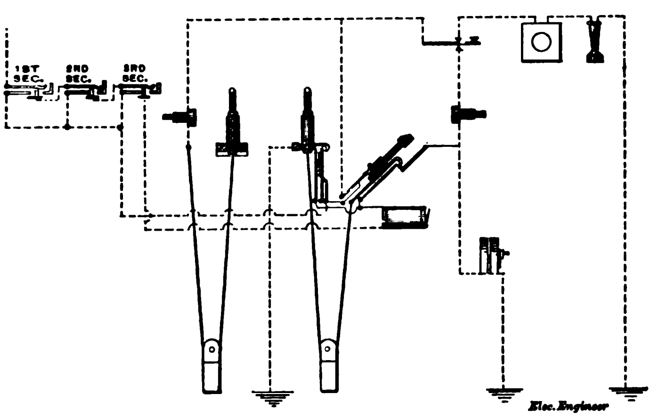
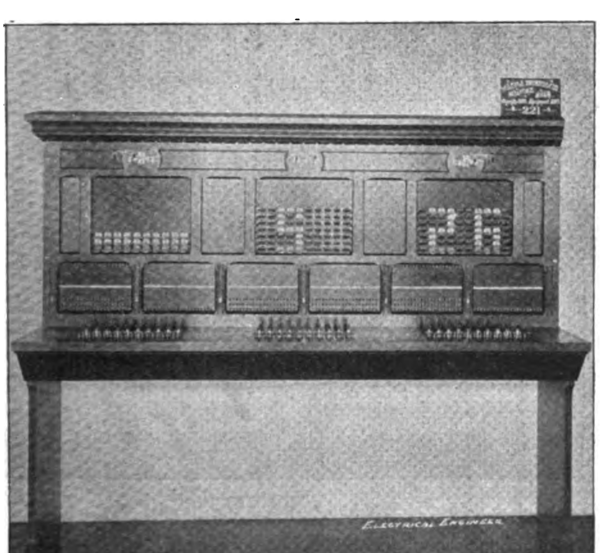


DIAGRAM OF CONNECTIONS, 1887 MULTIPLE BOARD.

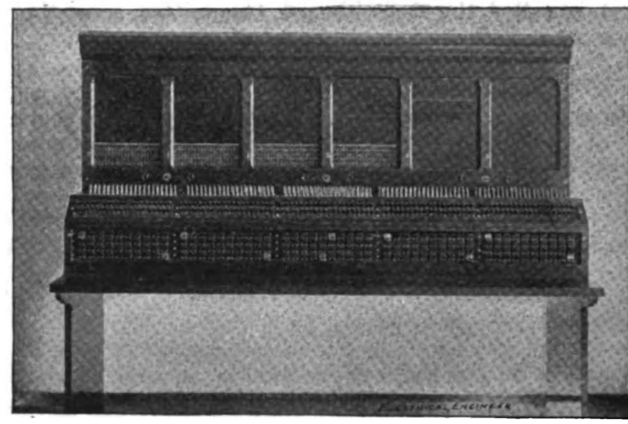
they come from the underground conduits and connects them with lugs along its entire face.

From these lugs, the distributing wires run to another set of lugs which are connected with the switchboard proper



THE 1891 MULTIPLE BOARD FOR SMALL EXCHANGES.

and which are on the opposite side. The line then passes through part of the protective system, consisting of an air space carbon plate, as a safeguard against direct high



THE 1887 MULTIPLE TELEPHONE SWITCHBOARD.

potential currents, which it leads to earth, and then through a thermostatic or heating coil for arresting the sneak currents that burn the annunciator wires. At the extreme end of the underground cable are the fuse wires, which protect the system from the heavy currents that would

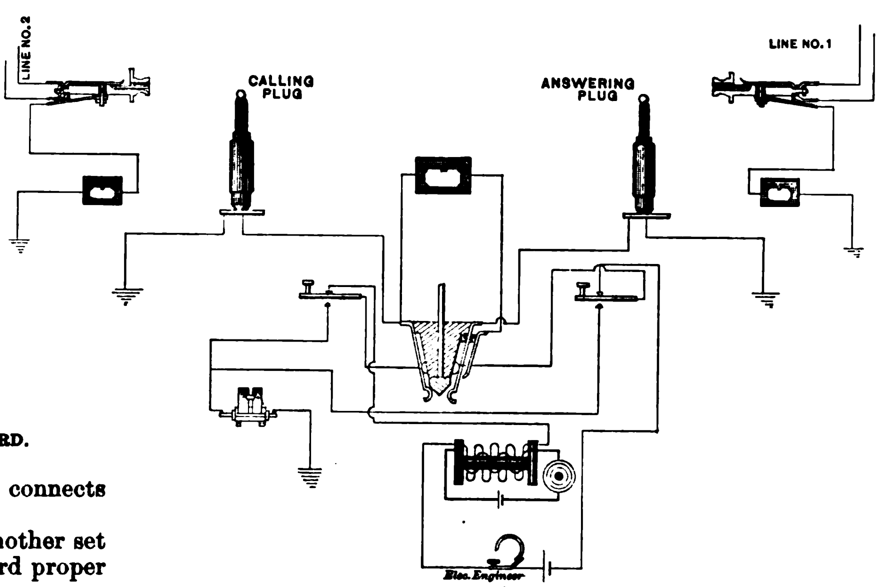


DIAGRAM OF CONNECTIONS, 1884 MULTIPLE BOARD.

endanger the office wires. From this point, the lines are carried to the intermediate distributing board by means of paired office cables. Connection is also made in this way by twisted pairs from the intermediate board to the spring jacks of the main board, and another set to the regular, or line, jacks of the multiple.

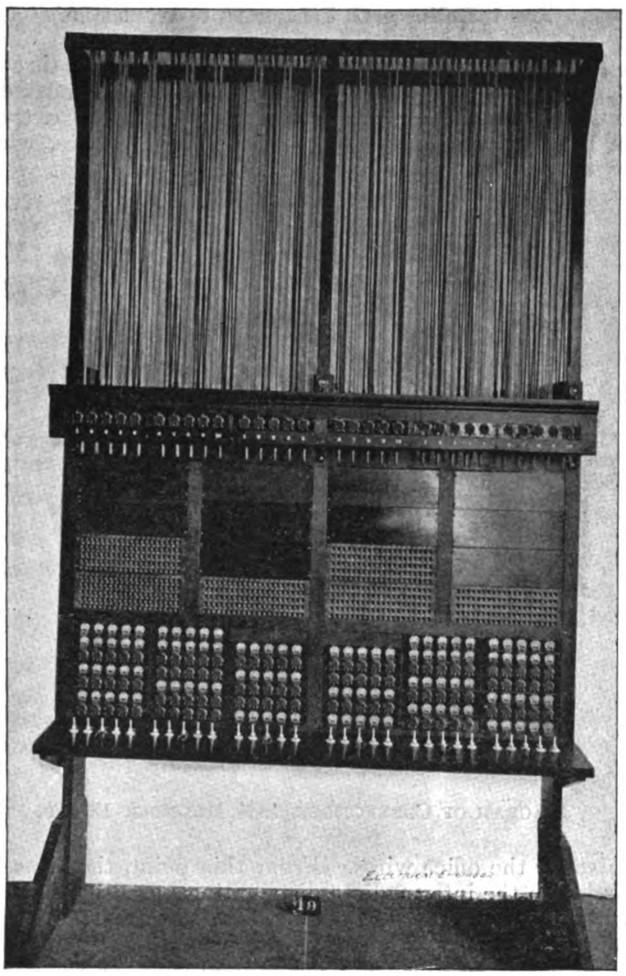
The new branch terminal board is so arranged that a line can be ended on any annunciator, regardless of the subscriber's actual number; owing to this arrangement, the subscriber's position on the switchboard can be changed as often as desirable, without the slightest incovvenience to him, or to the operator. The call bell circuit is always closed; this, of course, requires a locking drop, in order to prevent the section operator from getting a false call, because the annunciator is always on the line; and added to this is the self-restoring feature. Both of these are obtained by the employment of a local circuit, closed through the annunciator of the lines and connected by means of special contact rings on the operator's connecting plug. The local circuit which restores and locks the annunciator also supplies means for the "busy test." When the operator sees the clearing out annunciator drop she presses a lever, which inserts her telephone in the cords indicated by the clearing out annunciator drop.

With this board an operator is able to reach 5,400 subscribers and 240 trunk lines. It represents the work of

what is called the Switchboard Committee, consisting of the most experienced telephonists all over the country.

III.

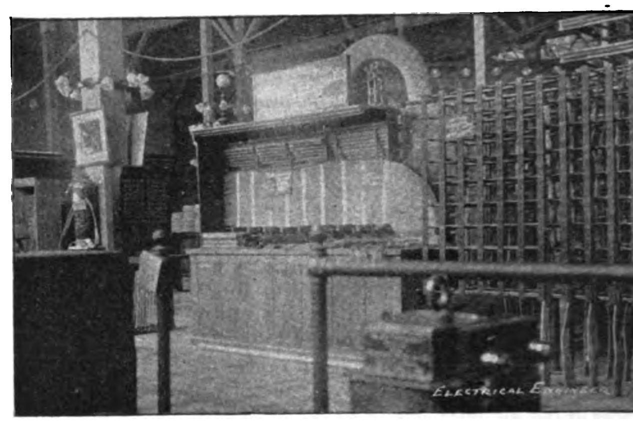
In the space devoted to cables and wires we find a variety of conductors adapted for every possible system and character of transmission from annunciator wire to armored submarine cable. Included among these is the so-called switchboard cable which is used only for multiple switchboards and is made up especially with that end in view. The wire is tinned, and when ready to be applied to the board, is cut in short lengths; it requires no acid for cleaning, and is ready at once to be soldered. The insulation consists of two windings of silk tussah, which is used on account of its non-hygroscopic quality, in which respect it



THE 1884 MULTIPLE TELEPHONE SWITCHBOARD.

differs from cotton and paper, which absorb moisture to a greater or less extent. Over this is put one or two layers of cotton in order to increase the bulk of the cable, the idea being to make the electrostatic capacity as low as possible. The wires are laid up in oval form, the cable being about $\frac{7}{8}$-inch wide and $\frac{5}{8}$-inch thick. It is wound with lead ribbon, which, though not adequate to shut out water if the cable be completely submerged, is, nevertheless, quite effective in shedding any water which might be poured upon it in case a fire should break out in a telephone exchange. Finally a braid painted with fireproof paint, is put over the cable. This braid will not burn, and hence will not carry the flame from one part of the board to another. As remarked above, this cable is made only $\frac{5}{8}$-inch thick, for the reason that the strips which contain the holes for the plugs, are of the same width, but as there is plenty of room back of the board, it is flattened in a horizontal direction to $\frac{7}{8}$-inch.

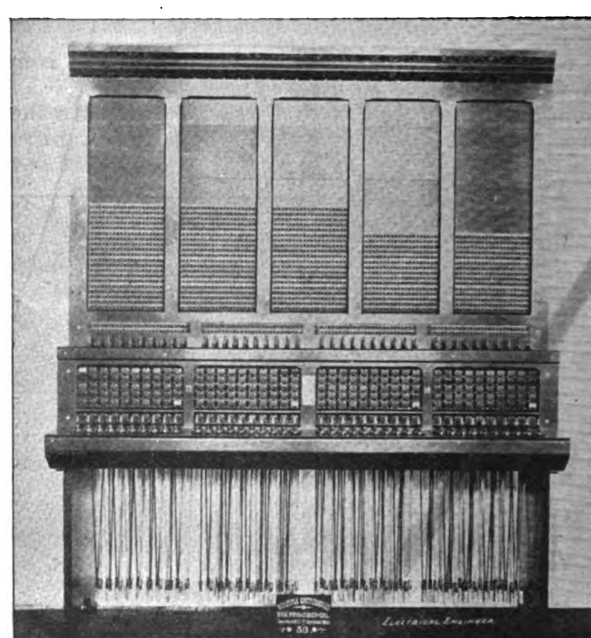
In making up the connections of telephone switchboards,



REAR OF BRANCH TERMINAL AND DISTRIBUTING BOARD.

a special solder is used, which is exhibited in an adjoining case. It consists of a tape of solder rolled lengthwise into a thin spiral rod, and enclosing within it the rosin sufficient to flux it. With solder so made up, it requires only the touch of the soldering iron to the tinned wire to make the joint. It is evident that the employment of acid would be accompanied by corrosion and would attract moisture that would lower the insulation resistance. The employment of glycerine instead of acid is subject to the same disadvantage, but rosin, on the contrary, is free from these drawbacks, while, in addition, it acts as an insulater to protect joints when made. From the success with which this form of solder has met in telephone work, it would appear to be excellently adapted for general electrical soldering work in electric lighting and power circuits.

Among the comprehensive exhibit of insulated wires,

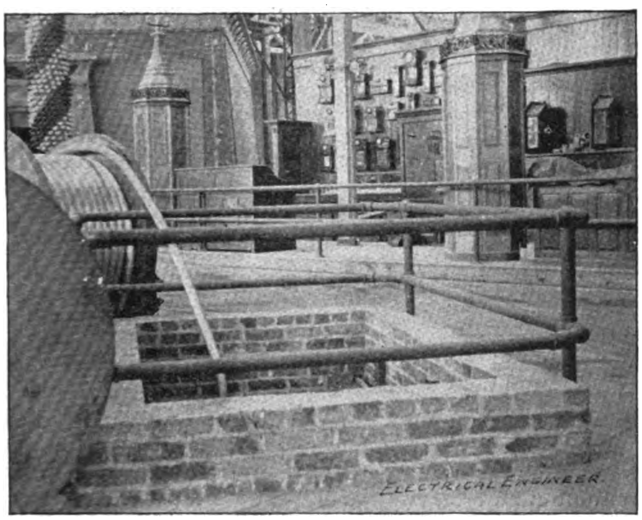


"ANTWERP MODEL" 1885 MULTIPLE BOARD.

with which this space is filled, we find weatherproof wires for electric lighting, with insulation consisting of cotton soaked in various insulating materials, and cotton wires for magnet and armature winding, of various sizes.

Among the latter we note silk-covered wires in heavy sizes sometimes employed in high-tension machines where extra insulation is required. Trailed in festoons in this part of the exhibit also, is a continuous spiral of copper wire made in a machine for coiling rheostat wire. This machine, designed and built at the works of the company, can take wire of any length and turn out spirals without a joint of any kind and of any desired length. Usually these rheostat coils are wound on a mandrel, and their length is limited by the length of the mandrel on which they are wound. The machine above mentioned is able to take in wire from No. 16 to No. 10 B. & S. gauge.

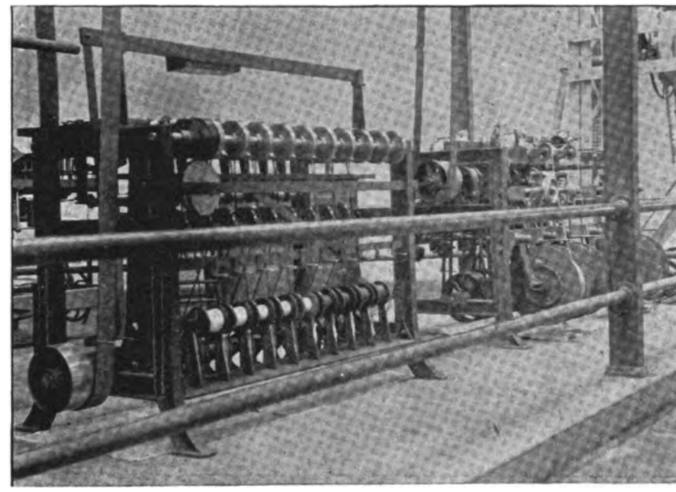
In an adjoining section, we find various forms of flexible conductors and switchboard cords, single, double and quadruple, made up of tinsel or spiral copper. The tinsel employed in these cords is $\frac{1}{32}$-inch wide and $\frac{1}{100}$-inch thick. It is wound around a thread as a core, in order to make it possible to handle it as a conductor, and five of these threads are then twisted in one; finally, three of these five-thread twists are stranded in a cording machine. We also note a switchboard cord, consisting of a tinsel braided around a core of linen thread and then reinforced by a brass wire wound spirally around it; this makes a strong



A Cable Manhole.

and good conductor, and is especially adapted for long switchboards.

The Western Electric Company were among the first to take up the manufacture of lead covered cables, and their exhibit at the World's Fair shows the extent to which this department of their work has been carried. Thus we find lead covered cables carrying from 1 to 15 conductors, up to the largest sizes. Others containing 100 pairs of No. 19 B. & S. conductors made to the Cable Conference standard specifications, having an outside diameter of $2\frac{5}{32}$-inch with the lead covering $\frac{1}{8}$-inch thick, and with an electrostatic capacity of .08 microfarad per mile. It may not be without interest to recall here, that as early as 1880, Mr. W. R. Patterson, of the Western Electric Company advocated the employment of dry cables, and in order to test the soundness of his theory, he experimented with a cable in St. Louis, insulated by the Brooks method, in oil, and inclosed in an iron pipe. When the cable had been drawn in, Mr. Patterson plugged up the connection between the pipe and the oil reservoir and filled the *reservoir*, leaving the pipe and cable perfectly dry. The cable worked well, and continued to do so. Its length was between 1,800 and 2,000 feet, and it passed over the St. Louis Bridge. Later at Milwaukee, a similar experiment was made with a cable running under water, and with equally good results. The history of the evolution of the dry cable would be interesting, but we can only here refer briefly to its various stages. Beginning with the paraffine cables, the next step was the employment of paraffine and air; then came a still



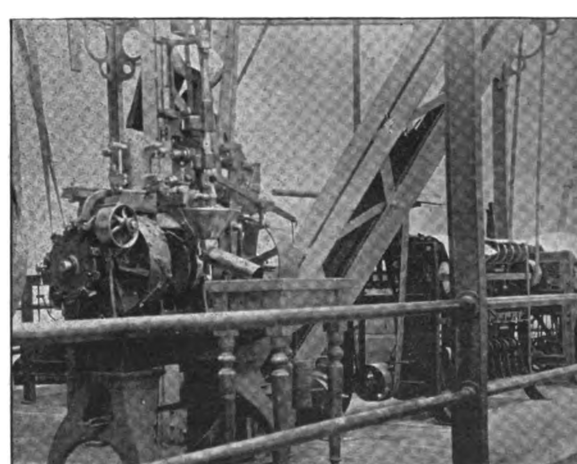
Paper Taping Machine and Winder.

further increase in the amount of air injected in order to reduce the electrostatic capacity, until finally air alone came to be employed. The result of these successive improvements has been, that, beginning with a capacity of over .2 microfarad, the electrostatic capacity of telephone cables has now been reduced to less than .08 microfarad. Included in this exhibit also, are samples of cable splices and joints, and also a pole-box with a Hibbard lightning arrester, consisting of tin-foil wound around asbestos.

In order to illustrate the method of laying and drawing in underground cables, a full size manhole and complete cable-drawing outfit are shown, including a full kit of tools for making joints, rodding, winch, etc., as illustrated on this page.

IV.

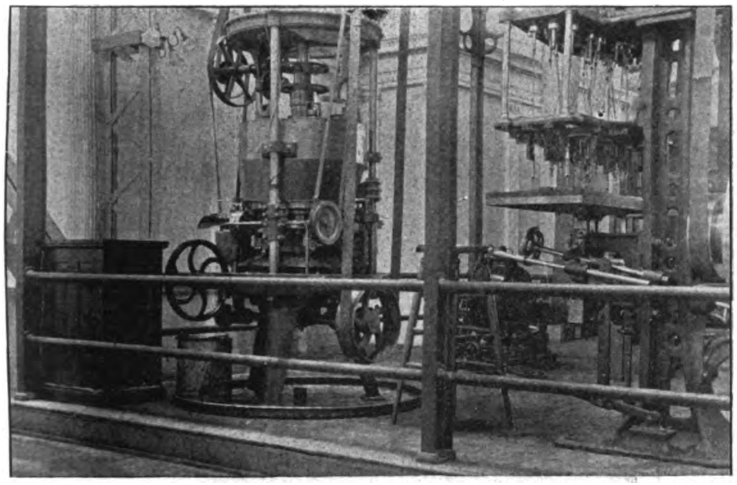
We may here properly pass over to the section of the exhibit devoted to the covering of wires, which is shown in actual operation, and which attracts much attention from the public. On the extreme right of this part, is a machine for winding cotton and paper tape, intended for the insulation of wires which go to make up the new type of telephone cables. The paper tape, before being applied to



Automatic Screw Machine.

the wire, is embossed, or creased, along the centre so as to weaken it at that point, in order that it may give in the centre, rather than on the edge where it would be most apt to tear when folded around the wire. The machine applies

the paper loosely so as to get a proper amount of air space around the conductor for the purpose of reducing as much as possible its electrostatic capacity. Two such paper tapes



AUTOMATIC NUT MACHINE.

are wound around each wire, and in the same direction, but overlap each other, and when they are finally cabled, the tapes are purposely slightly untwisted so as to increase the air space. We also note on this tapeing machine that the rolls which guide the paper, instead of revolving loosely in their pivots are driven at a speed faster than the motion of the paper itself, in order to remove all friction. This device has been applied to all winding machines in the Western Electric Company's factory, with the result that they can be run at double the speed, and the wire comes out without the spiraling or twisting tendency so fre-

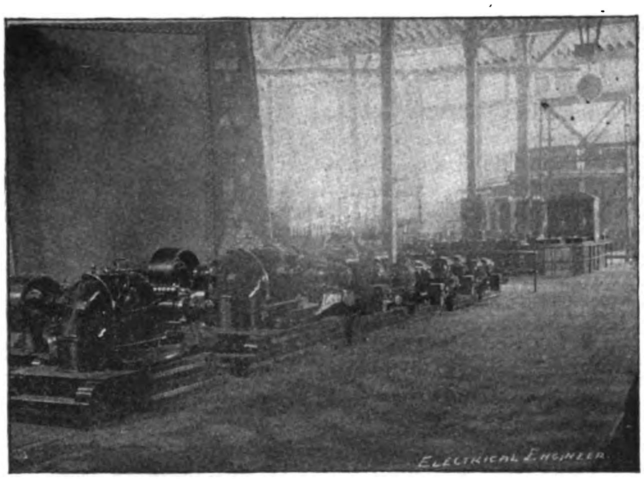


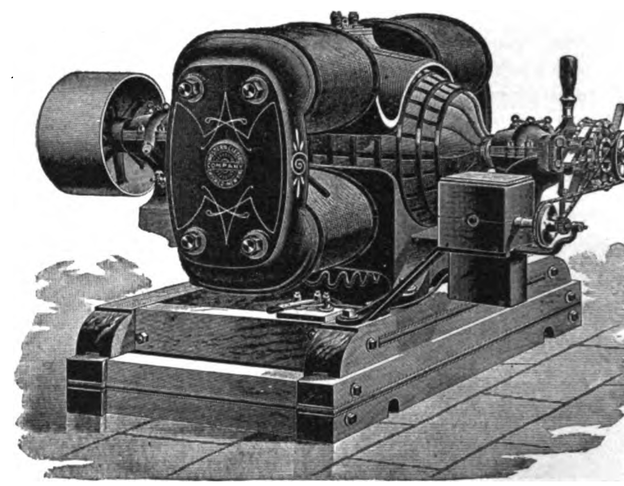
EXHIBIT OF INCANDESCENT LIGHT MACHINES.

quently met with in the smaller sizes. Close beside this machine is another for winding silk magnet wire, and a triple braider, which also was first applied by the Western Electric Company.

The automatic screw machine in this section, designed by Mr. O. P. Briggs, of the Western Electric Company, deservedly attracts the attention, not only of the lay public, but also of all interested in automatic machinery. This machine turns out the work completely finished at both ends, and the variety of forms which it is able to handle is practically without limit. Another machine beside it, is a drill press with drills run by shafts geared through universal joints. In this way the drills can be shifted about and set as closely together as desired, and all the holes drilled at once; it is employed largely in drilling the back boards of telephone sets, magnets boxes, etc. The jig can be set to any design on account of the employment of the universal joint and sliding sleeve. Adjoining this machine, is another for making hexagon nuts out of brass ribbon, which is punched, drilled and tapped; all these machines are due to Mr. Briggs' ingenuity. Finally, there is exhibited a machine for winding magneto armaturus. This is provided with a test set for measuring resistance as the winding proceeds, and testing for broken wire. All these machines are driven by a four-pole Western Electric motor.

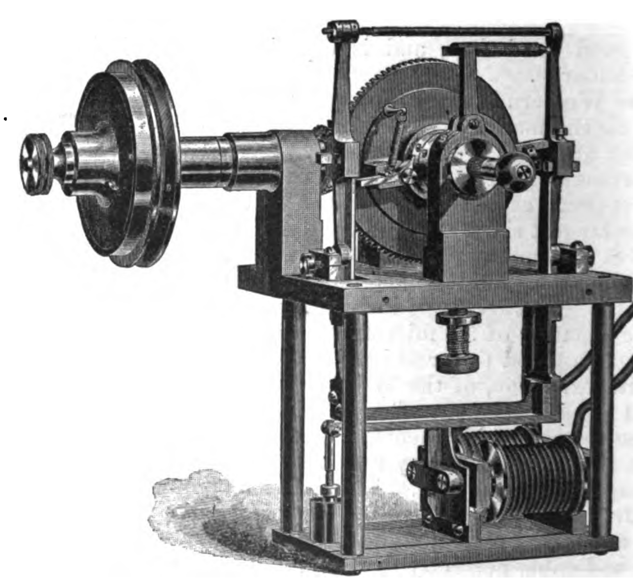
V.

The electric lighting and power exhibit of the Western Electric Co., comprises a complete set of dynamos for arc and incandescent lighting of various types in Electricity Building, and a large plant in operation in Machinery



THE WESTERN ELECTRIC ARC DYNAMO.

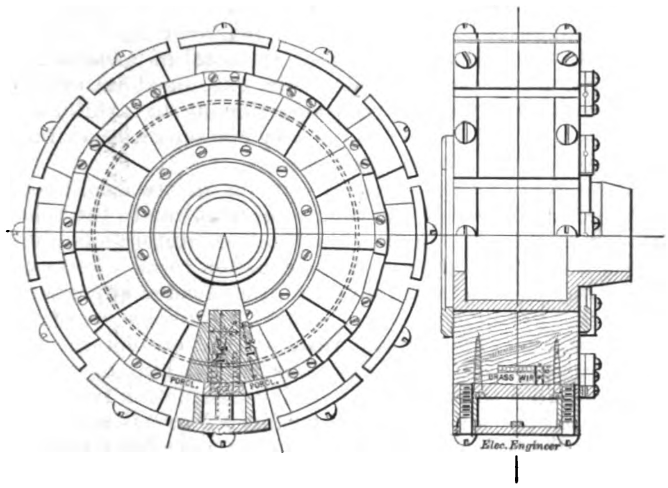
Hall affords an excellent opportunity of studying the action of the machines in service. The arc machine, illustrated on this page, is of the consequent pole drum armature type, operated with two carbon brushes on each side, placed one segment apart. The commutator is specially designed to allow of the easy replacing of worn out segments, and its construction will be readily understood from the diagram, page 323, which shows it in two views. It will be noted that air insulation is employed, The commutator is built up,



THE WESTERN ELECTRIC ARC DYNAMO REGULATOR.

on a brass sleeve, or core, on which is mounted a cylinder of dove-tailed pieces of hard wood, which are firmly bound together by brass wire. Upon this wooden cylinder as

a base, there are mounted brass pieces to which the commutator segments proper, of copper, are screwed. These



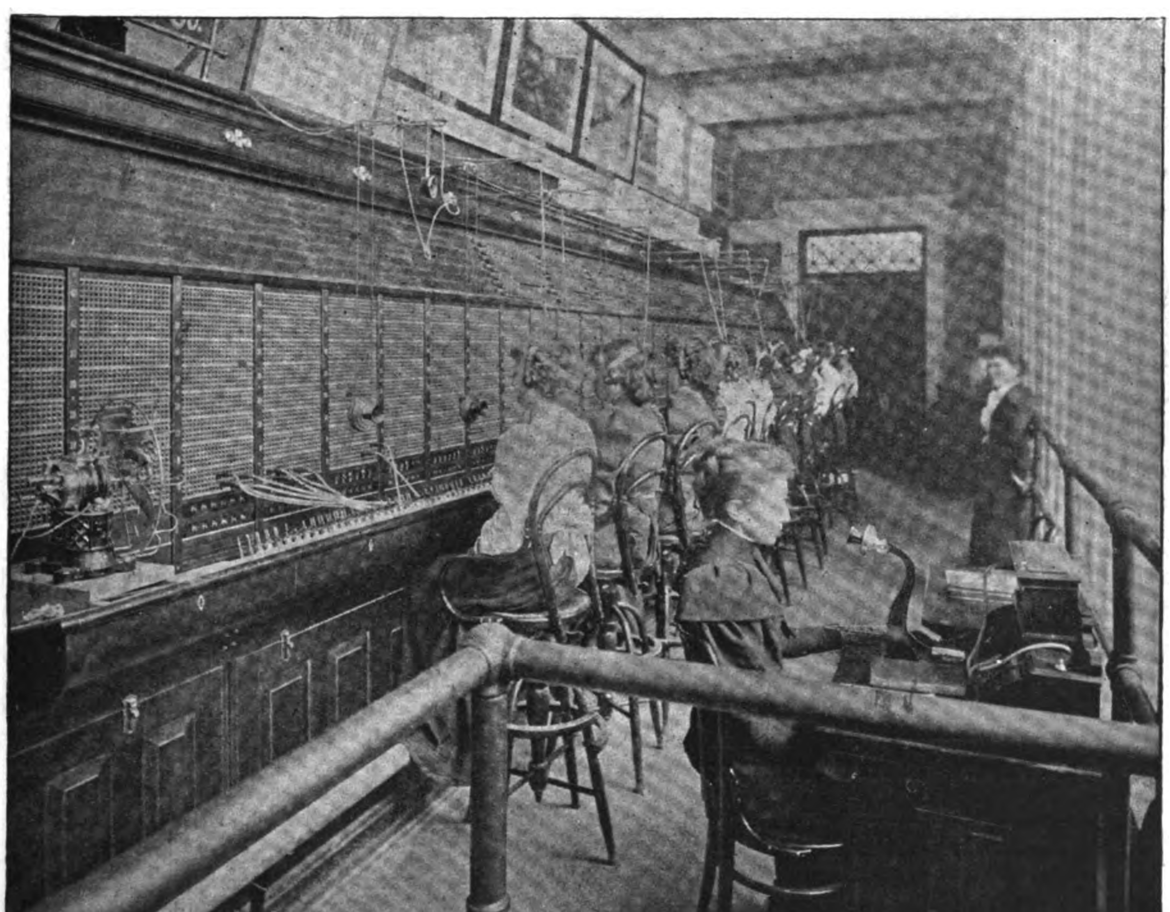
DETAIL OF ARC DYNAMO COMMUTATOR

segments overlap the brass pieces, and thus permit of readily cleaning out the air space, which forms the only insulation between the commutator segments.

The armature is wound with a view to reducing the sparking at the commutator to the smallest possible degree, and the method employed is shown in the illustration, page 324, the coils being numbered in the order in which they are wound. One layer of a coil, for example, is wound in the upper space 1, and in one of the lower one-half spaces marked 1, and the next layer in the other half space marked 1; and so on until the upper space 1 has twelve layers and the lower half spaces have six layers each. The next coil is put on in the same way in the spaces marked 2. The long and short coils are thus arranged so that the resistance of the two halves of the armature which are put in parallel by the brushes practically balance one another. The regulation of the machine for constant current is maintained by a regulator which is shown in perspective on page 322, and which is driven directly from the shaft of the dynamo by a round leather belt. The brushes, however, can be regulated independently of each other.

The action of the regulator depends upon the change in strength of a magnet placed in the main circuit. This magnet acts upon an armature attached to a frame which carries two projecting lugs placed in the path of a pair of tappets attached to the shaft and which in turn act upon a nut threaded upon the shaft and connected with the brush holder. When the current is of a normal strength the armature and its attached frame are in such a position that neither of the tappets are thrown into action, both just clearing the lugs. Any increase or decrease of current, however, causes a change in the position of the susp nded frame and brings one or the other of the tappets into action and shifts the brushes in such a way as to bring back the current to its normal strength.

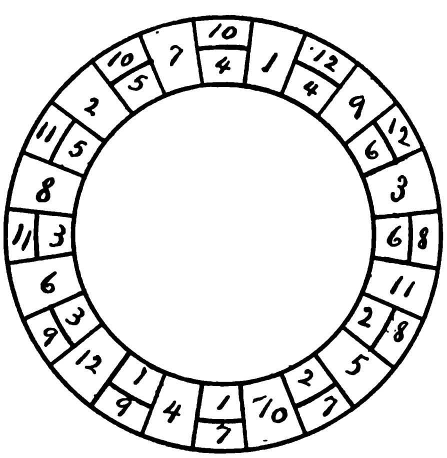
The work done by the Western Electric Company in arc lamps is well demonstrated by those in actual operation in Electricity Building and in various parts of the Exhibition grounds. Among them we find the various types of lamps for consant current and constant potential circuits, the external parts of which are illustrated in the engravings, page 324, and which are made both single and duplex. One of the lamps intended for constant current cir-



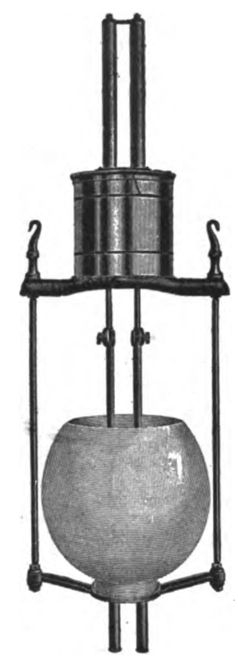
THE NEW BRANCH TERMINAL BOARD.

cuits is provided with a series and a shunt coil and with a clutch movement, and its action will be understood by a glance at the diagram on this page. It will be noted that when the current is first turned on, the series or main magnet M attracts its armature and keeps it permanently attracted as long as the current is on, making the point A a fixed fulcrum for the system operated by the shunt magnet S. This magnet operates upon an armature attached to the bent lever B, which is pivotted at C and the motion of which is opposed by the spring S. The lever B in turn acts upon the armature D which is directly connected by a link to the arm E which controls the clutch surrounding the carbon holder. Any deviation from the normal length of the arc causes the shunt magnet S to allow its armature to recede. The spring S pushes the lever B, which, acting through the other levers of the combination allows the clutch to open slightly and permits the carbon rod to fall until the normal length of the arc is again established.

In the arc lamp intended for incandescent circuits a rack movement is employed in which a shunt coil controls the brake of a gear train that feeds the carbon.



Method of Winding Arc Armature.



The Western-Electric Duplex Arc Lamp.

The Western Electric Constant Current Arc Lamp Mechanism.

In addition to the regular arc lamps for street and interior lighting there are also shown a number of stage and theatre lamps with the lens boxes for colored light effects. We also note the focusing lamp also intended for this class of work which operates in any position and embodies in its construction a spring which balances the action of the two carbon holders.

FURTHER AWARDS IN ELECTRICITY DEPARTMENT.

We have received from Prof. W. E. Anderson, secretary of the jury, the following additions to the awards made in Electricity Department. There have now been 195 awards made, and about 30 more will be given out, although the exact time is not known at this writing. The incandescent lamp awards, for example, await the result of the tests, and the report is not expected before Dec. 1. Of the 195 awards, 49 are foreign, and of the remaining 30, a few more will go abroad, to further reward the enterprising and public-spirited firms and governments that have done honor to the World's Fair by their presence. It goes without saying that with so large a display, the General Electric Co. takes lead among American prize winners; and it appears to have secured 30 awards, with perhaps one or two more in the offing, about to come in. The Westinghouse Electric Co., with what may be regarded as a more select and specific exhibit, has won a baker's dozen of awards, and is still on the expectant list.

It would appear, therefore, that the total of awards for Electricity Department falls within 230, or about one to every two exhibitors. The proportion as to exhibits is much less, as there are no fewer than 2,800 separate exhibits enumerated in the electrical classes.

With regard to the general system of awards, Prof. Anderson has little information to give out as to the relative stages of merit upon which each exhibitor finds himself placed. The bronze medal is common to all who have awards, but the intrinsic value of the decision appears to rest in the wording of each diploma. Into that wording the successful exhibitor can read all the encomium and encouragement that his convictions entitle him to, while his undecorated competitor can derive satisfaction from the reflection that nobody is "A1" or "XXX" or "Best Best," and that nobody has received more than a shadowy title to dominion. An inquiry among the exhibitors shows that many of them would have preferred to be more definitely rated by their exact deserts, but that all of them propose to make the most of that which comes to repay them in part for costly preparation and long months of weary attendance and expense. Even now, from time to time, in this the last month of the Fair, they can be seen adding new things and interesting novelties to their respective exhibits.

UNITED STATES.

The Electrical Engineer; Historical Electrical Railway Model (Davenport's).

General Electric Company; Incandescent lamps used for decorating rooms and other structures.

A. H. Phelps; Electro-pyrogravure process.

Westinghouse Electric and Manufacturing Company; High tension experimental apparatus.

AUSTRIA.

Schindler & Jenny; Electrical cooking apparatus.

GERMANY.

Hartmann & Braun; Galvanometers of special form.

Reiniger, Gebhardt & Schall; Electro-medical apparatus.

The exhibits of the Allgemeine Elektricitäts-Gesellschaft and of the American Institute of Electrical Engineers

received no award; these being considered by the Committee on Awards to be "hors concours."

It is interesting to note in this connection that the French government has followed out to the end the independent policy with which its commissioners began in the matter of awards. The announcement is now made that the judges who have been at work on the French exhibits have finished their labors in a series of reports, and that upon these reports, gold, silver and bronze medals will be awarded in due course. Such a system, as distinguished from the American method, appears to be approved by our native exhibitors; and it is evident that no matter how high the American excellence, it is doubtful whether the French gold and silver medals will not eclipse the Thatcher bronze ones, no matter how much enthusiastic praise may be wrapped up in the accompanying diploma.

PREPARING FOR CHICAGO DAY, OCTOBER 9.

GREAT preparations have begun for Chicago Day, on October 9, when the Black City, with that wonderful public spirit that has made her what she is in trade, commerce and finance, will send half a million of her people to the White City to rejoice with each other in what they have there shown as an earnest of their taste in art and science, and their yearning for all the things that render life the better worth living. Many of the exhibitors are making special preparations for that day, and electrical Chicago is to be out in force. Every motor will be oiled, and every burned-out incandescent will disappear from the circuits, replaced by a new one.

One of the noteworthy features of the great day and greater night will be the procession or parade, and in this, naturally enough, electricity will play a prominent part, as it did last October in the night parade in New York. One of the finest floats will be wholly electrical. The cost of this, it is stated, is to be borne jointly by the General Electric Company and the Chicago Edison Company. The design is certainly a novel one. It was first proposed to have a huge globe with parallels of latitude and longitude formed of ribbons of electric lights, but as there was already to be one globe in the pageant, the electrical people hit upon another plan. Upon a platform 38 feet long and 9 feet wide it is proposed to erect an enormous papier maché dragon, of the most horrible form and aspect. The dragon will have a mouth big enough to swallow the whole of creation, and every scale upon his body will be masked by an incandescent light. To cover the beast thoroughly and give him a sufficiently fiery aspect, will require something like 2,500 lights. The dragon will be made to take on a shining hue, changing every second into green, blue, bronze and all sorts of colors. As Chicago dragons necessarily emit fire and smoke, this effect will be worked up by sending from his mouth and nostrils the exhaust steam from the boiler which will be carried under the truck to supply the engine. The dragon will also have the ordinary wings of a dragon, tipped with incandescent lights. Eight horses will draw this creature. Immediately in front of the horses will be another truck, on which will stand the genius of electricity in the form of a woman. She will hold a fairy wand in her hand, at the tip of which will be placed a light, supplied with current from the dragon behind. This float will probably be made under the direction of Mr. Millet down at the fair grounds. The body of the dragon will be wholly of wire and papier maché.

THE MANHATTAN INDUSTRIAL EXPOSITION.

OWING to the determination to close the World's Fair at Chicago on October 31, and at the solicitation of foreign exhibitors, who propose exhibiting there, it has been decided by the management of the World's Fair Prize Winners' Exposition to change the date of holding same from February and March, as originally intended, opening on or about November 24, 1893, and closing January 15, 1894.

THE INTERNATIONAL PATENT CONGRESS AT CHICAGO.

THE CONGRESS OF PATENTS, TRADEMARKS AND COPYRIGHTS, October 4, was very poorly attended, although some interesting papers were read. Hon. Richard Pope, Canadian commissioner of patents, was the first speaker, his subject being "Relation of Inventions and Patents to the Industrial Progress of Canada." Great benefit had accrued from them, he thought—much more than was generally believed. They marked the commercial advancement of a country and the greatest protection should be given inventors. "The Epoch-Making Inventions of the World," was the subject treated of by L. L. Bond, of Chicago. He said that in some instances the inventions of a people gave almost the only idea of their history that we had. Great inventions could and did change history as they marked epochs.

Carroll D. Wright discussed "The Effects of Inventive Genius on Labor. "L. W. Serrell, of New York, discussed "Uniformity of Patent Laws," and Eberhardt Faber, of New York, "Trademarks from the Manufacturer's Point of View."

Thos. D. Lockwood, of Boston, read a paper on "The Influence of Electrical Inventions," tracing briefly the familiar story of discovery and invention from the mariner's compass to the telegraphs, telephones, lights and motors of to-day, and pointing out the special influence of many important electrical applications and dwelling upon the general influence of each of the earlier and broader discoveries to stimulate further and wider spread investigation.

THE WORLD'S FAIR ELECTRIC BUOYS.

A LETTER recently received by Mr. Ira W. Henry, from Capt. J. J. Brice, U. S. N., Inspector 9th Light House District, reports that the electric buoys at Lake Michigan, installed by the Bishop Gutta Percha Co., and extending from the foot of Van Buren street, Chicago, to the World's Fair grounds have been running as regular as clock work since their acceptance by the Government. None of them has failed for a single night. During the heavy storm of a few weeks of ago the waves ran six feet high yet none of the lights went out. This seems to prove their feasibility for ocean work.

COLLEGE NOTES.

ELECTRICITY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

THE extensive course in Electrical Engineering at the Massachusetts Institute of Technology forms the subject of a highly interesting pamphlet of 45 pages issued by the Faculty of that institution. The origin and characteristics of the course and the character and the sequence of studies, occupy the first ten pages, after which is given a detailed description with a synopsis of the curriculum and a schedule of lectures, recitations and laboratory work.

A special series of lectures on the phenomena and general principles of electricity, runs parallel with the latter portions of the course upon general physics, so that at the close of the second year the student possesses a good knowledge of the fundamental laws of electricity. During the third year he acquires some idea of the applications of mathematics to the study of electro-statics and electro-kinetics, and in the fourth year is given a course particularly devoted to alternating currents.

The instruction in the technical applications of electricity begins with a course of lectures on the principles and methods of telegraphy in the third year. In the fourth year are given extended courses of lectures upon submarine telegraphy, the telephone, electric lighting, and the electrical generation, transmission and utilization of power. The arrangement of central stations and the peculiarities of different types of dynamos are likewise considered. Also a course of lectures is devoted to railway signaling, and another to the distribution of electricity for commercial purposes.

Beside this a good deal of outside work is done and excursions are made by the senior class to various typical electric light and power stations and manufactories, and before being graduated each student is required to present a thesis upon some electrical subject.

The laboratories and workshops of the Institute are equipped with the most modern and approved apparatus and machinery, and no pains or intelligent effort have been spared to make the course thorough and complete.

ELECTRICITY IN AMERICAN MINING.

MR. F. O. BLACKWELL states that there are more than 300 companies in the United States that employ electricity in mining operations for light and power. Fully one-third of the copper refined in this country is treated electrically.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XVI. NEW YORK, OCTOBER 11, 1893. No. 284.

THE BUSINESS SITUATION AND GENERAL ELECTRIC.

ELECTRICAL industry and trade have been drifting about in the doldrums for some months. The greater part of the fleet has now found its way into a fair sailing breeze but has yet to strike a brisk trade wind. It is sure to find it ere long, unless the majority of the United States Senate commit the incredible folly of permitting a squad of silver mine Senators to override them, the House of Representatives and the people, and plunge the country into worse financial disorder than that of the past summer. The period of stagnation, accompanied by disaster here and there—the entire or partial collapse of unsound or imprudent concerns—developed a strain that brought out the weak spots in policies and methods that had not yet been wholly weeded out of electrical business, and the revival may be expected to bring with it a more general adoption of careful and conservative principles of trading and financing in the electrical field.

We have already directed attention to the marked change in the situation brought about by the vicissitudes of the General Electric Company during the past year. That company is very far from constituting to-day the compact and formidable monopoly that its managers sought to achieve. While it has secured a preponderance of decisions sustaining the Edison patent in the various infringement suits, it has not closed all the infringing lamp factories. Its legal successes have had the effect of stimulating invention to such an extent that in a few months non-infringing lamps have been developed and put upon the market successfully by enterprising manufacturers who were enjoined under the Edison patent. The General company has met with intense and successful competition in the railway field from the Westinghouse company and others, who still continue to get a good share of the business. Moreover, the prestige of the General Company has been seriously impaired by the enormous depreciation of its shares and securities on the Stock Exchange; while its repute has suffered, not only in the estimation of the electrical trade but in that of the general public, through the persistent charges of objectionable methods of business and financeering, and through the general belief that the company has been in great straits for money. So great has been the depreciation in its stock that nearly two-thirds of the market value of its shares have been wiped out within a year; the depreciation having occurred for the most part before the financial storm of the summer. These things are mentioned here because the uncertain position and attitude of the General company have been, in effect, a sort of incubus upon the trade in general ever since the consolidation of April, 1892, creating doubt and uncertainty as to the value of existing investments in electrical business, and timidity in expansions or new ventures. The real size and weight of the minatory giant are now more clearly discerned. He is surely not so big, and perhaps not so bloodthirsty, as he seemed a while ago.

A further circumstance in the situation of the General company should be of advantage to its competitors. The recent overhauling of its affairs and methods of business in the interest of large owners of the property has apparently led to the abandonment of the old Thomson-Houston practice of loading up the treasury with all sorts of local stocks and bonds received in payment for the products of the factories and to the inauguration of sales on a cash basis only.

An adherence to this sounder practice will relieve from an unequal competition competitors who will not or cannot carry the obligations of customers for an indefinite period with uncertainty of ultimate payment, and will eventually benefit the General Electric Company as well. That company, with its wings clipped, and keeping perforce near the earth instead of seeking the sun, moon and stars, will gather legitimate strength, while its competitors will know better where to find and meet it than they did a year ago.

THE BRAKING OF STREET CARS.

THE discussion recently started in our columns on the desirability of putting electric street cars under more perfect control has interested far more of our readers than we anticipated it would, and we have already received a number of valuable communications on the subject. We are glad to be able to publish in this issue a short but very pithy article from Mr. E. H. Johnson, who has taken the trouble to go into the statistics of the matter, and presents a remarkable summary of the evidence, going to prove very conclusively our statement that the motorman was unduly held to blame. It is only proper here to say that our attention was first called to the immediate importance of this question by Mr. E. H. Johnson himself, who is certainly one of the first men to recognize the appearance of new problems in the art and the first to aim at their solution. His white plume is ever to be seen at the front in these fights for improvement; and it is sincerely to be hoped that, as the result of agitation and invention, improvement may soon come.

ELECTRIC RAILWAY DEPARTMENT.

THE PROBLEM OF STREET CAR BRAKING.

BY E. A. SPERRY.

THE inefficiency of most of the present mechanisms for braking and stopping electric cars is marked, and becomes especially manifest when the matter is put to the test or even cursorily investigated. The large increase in speed and weight of the moving mass has, as very well stated in the able editorial in THE ELECTRICAL ENGINEER of Sept. 27, 1893, not been met with anything like a commensurate advancement in methods of quickly and easily effecting the stopping. The brake at best is a problem. On some equipments and styles of truck it is very difficult to get the brake levers, mechanism and connections for application in at all, and in some instances this difficulty has resulted in indifferent design and poor construction, not the fault so much of the builder as of the conditions imposed in the equipment as a whole.

The problem of braking has been one of interest to me for years. My first business undertaking some years since had a "brake" incorporated in its name as well as attached to its history. Those were the times of horse cars, and the power economizing brake for yielding up energy in starting was one to which I applied unlimited time and some skill. The problem was solved, but the expense of its application was then prohibitory. Inasmuch as great advancement has now been made in means for overcoming the inertia and pouring into the moving car or train an amount of power that is simply enormous, I am firmly convinced that a corresponding advancement should be made in braking and more powerful and effective means provided for divorcing the *motion* and *mass*.

As steam-road practice, road bed, speeds and weights are gradually approached, their experience in the solution of this most important problem should be studied with care. In so doing, however, the features wherein the street-car problem is differentiated from the steam-road problem should be kept prominently in mind. We must remember that the locomotive engineer is provided with a complete, expensive and somewhat intricate apparatus with which to de-energize his train. The periods of its application are comparatively infrequent, and as to personal capabilites he is schooled and trained for years before ever being allowed to touch either the throttle or the triple valve. While working, his pressure gauges allow him to adjust the brake application to a nicety. The time element which is given for the total retardation and final stopping of his train is usually very large as compared with that allowed in street railway practice.

Of the two, the street railway problem is the most exacting, and in the hands of far more inexperienced operators; and yet we are told that the mechanism involved in its solution must bear only a small ratio to the constantly decreasing cost of the total equipment. I, for one, think this is hardly fair. I think the purchaser should be willing to spend money to effectually control the retarding car as well as the accelerating car. To be sure, as little expense should be incurred here as possible, but enough to fully meet the requirements. Its importance at once commands the attention of all, and commends the problem as such to the engineer.

Considering the inexperience of the operator and the responsibility which at times nigh about overwhelms him, I think that, as engineers, we should be willing to set a very high mark to be attained in the ideal brake for electric street railway service, namely: The use of but a *single controlling handle for everything;* starting, accelerating, retarding and braking; the trailer or trailers and all. Let the motorneer have nothing to think of except one handle, and two-thirds of the accidents now occurring will be prevented. Let this handle require no more exertion in its operation than the present controlling handle. Let the motorman fulfill his functions with as little physical exertion as possible; he will have a greater reserve for mental application when necessary. A motorman required to exert an enormous amount of brute force, constantly grinding at the brake has but little life left to apply in case of emergency. I agree with a prominent writer of a year or so ago on this subject, where he says that a multiplicity of handles is fatal in time of emergency. Were you ever present at an accident? I have seen the motorneer unconsciously turn the handle the wrong way when "rattled" and frightened by a terrible exigency in which he suddenly found himself, with consequences that were too horrible to reiterate. The motorneer was blamed. Who would have done better under the circumstances? In my judgment that motorneer was not so much to blame; he was handicapped.

Many may think the mark that I have herein set is too high for attainment. In my judgment, however, I am frank to say that I do not think it is. Of course the problem is a hard one, but almost every attainment of value has been reached along this same route. This emergency is our opportunity. Let us give the struggling street railway man at once a practical solution of the problem, being satisfied with nothing short of the ideal simplicity named, bringing up thereby the advancement in the brake to the high standard of excellence attained by the application of the power.

THE DUTY OF THE PUBLIC TOWARD THE TROLLEY.

BY J. STANFORD BROWN.

THE editorial in THE ELECTRICAL ENGINEER, on trolley accidents (Vol. 16, No. 282, page 285, issue of September 27), is certainly timely and to the point.

The public at large seems still to be under the opinion that the introduction of the trolley means simply a change from horse to power traction without any more radical departure as to methods or aims. If there was nothing to be gained by the substitution of electrical power than getting rid of horses, it is doubtful if the change would have been made. The question, however, is not a simple one, because the superior economy of operation with electric motors is so combined with gain made possible by increase of speed. In short, electric traction has entirely new aims. It means a new era in street railway work and this should be made clear and recognized by the general public.

The streets in which trolley roads are running, so far as the part occupied by the tracks is concerned, should be given up entirely to the electric cars. Ordinances should be passed requiring wagons and carriages or any other form of vehicles, to keep off the tracks, excepting in so far as they are obliged to cross from one side of the street to the other.

The question of danger need not necessarily be alarming. The danger from falling wires is very small with roads put up properly. The high speed should be recognized and the public should be warned to take care of themselves.

People must remember that they cannot dodge under the trolley cars as they did under the horse cars, without taking their lives into their own hands, and if they do this, they certainly cannot blame either the railway companies or the trolley system.

The braking apparatus on most of the cars to-day is certainly inadequate to stop the large and heavy cars, when a child runs suddenly in front of a car, although it is usually sufficient for purposes of passenger traffic. It, however, can be remedied; that is to say, it is possible to procure brakes and braking apparatus which will thoroughly control the cars. The expense of equipping five hundred or a thousand cars will, however, be a very serious item for the railway companies to consider, and it is a question if they should be obliged to incur it solely to prevent fools and children (neglected by their parents) from being run over. It seems as though it were fair that the general public, being warned, should take reasonable care of itself.

So far as the control of the electric current for operating the railroad is concerned, it is certainly very satisfactory and can usually be relied upon as a "danger brake" provided the cars are thoroughly inspected and taken care of in the shops.

The railway companies are fully aware of the necessity of training their men and are doing their best to provide efficient and careful men to run the cars. The public must do the rest.

THE CONTROLABILITY OF MOTOR CARS.

MR. DAVID E. LAIN, well known in early electric railway work, sends us the following suggestive communication:

Concerning the controlability of the trolley car, you taking up the cause of the motorman and urging a more complete braking equipment for the trolley car is, it seems to me, wise on your part and likely to lead to good.

It is, of course, not wise to scare the public, and there is really no occasion for alarm, yet it is certainly true that the hand brakes on trolley cars are entirely inadequate for the service, and without the "reverse" the motorman would be practically helpless whenever it became necessary to stop the car suddenly. More powerful brakes are a thing of the near future and your timely advocacy of them puts your journal in this, like in other things, in the van of electrical progress.

My views on the subject are those of one pretty thoroughly schooled in trolley practice from the pioneer days of the trolley down to the present.

PERSONAL.

HONORS TO VON HELMHOLTZ.

AMONG the many compliments and evidences of distinguished regard bestowed upon Professor von Helmholtz during his sojourn in America, including the Honorary Presidency of the International Electrical Congress at Chicago, none has been more notable in significance than the reception given Tuesday night, October 3, by President and Mrs. Low at the library of Columbia College.

Professor and Mrs. Helmholtz dined with Dr. and Mrs. Low at their home, 30 East Sixty-fourth street. They arrived at the college about 9 o'clock, and soon afterward guests began to pour in. Instructors Holbrook Cushman, Reginald Gordon, Herschel C. Parker, C. C. Trowbridge, Asa S. Iglehart, Herbert T. Wade, Henry S. Curtis, Joseph T. Monell, and Andrew A. Foyé, wearing their academic robes, presented the guests to Dr. and Mrs. Low, who introduced Professor and Mrs. Helmholtz.

During the two hours of the reception the library hall of Columbia was the scene of a gathering seldom equaled of men distinguished for scientific, professional and social eminence. There was a generous admixture of ladies in attendance, supplementing the graceful courtesies of Mrs. Low and Mrs. Helmholtz. The assemblage was strikingly representative of the best elements in the intellectual and social life of New York and vicinity; vicinity covering distances of hundreds of miles in some instances. As was fitting, in view of Professor von Helmholtz's electrical investigations, the company assembled to do him honor included some two-score of prominent electrical engineers and electricians of New York and other cities.

The tables and desks were removed from the library, and the floor was covered with rugs. The collection of oil paintings of the Presidents of the college and of other celebrated men of learning were hung from the balcony railing, and behind the railing the great lines and banks of books formed an effective background. In the corners and in conspicuous places were clusters of palms and ferns. A Hungarian orchestra in one of the balconies played sweet music during the reception, just loud enough if one wished to listen but not loud enough to interfere with conversation—making a most agreeable undertone to the quiet greetings below.

Among the electrical men present were: Alex. Graham Bell, Nikola Tesla, Prof. E. J. Houston, Prof. C. F. Chandler, Prof. O. N. Rood, Prof. A. M. Mayer, Prof. Geo. F. Barker, Prof. M. I. Pupin, Prof. F. B. Crocker, Prof. S. Sheldon, Edward Weston, Geo. M. Phelps, F. R. Upton, W. J. Johnston, S. S Wheeler, W. B. Vansize, R. Gordon and C. H. Davis.

On Friday Prof. von Helmholtz addressed the students of Columbia College on "The Scientific Method of Acquiring and Communicating Knowledge," in which he pointed out that such a method must be so arranged that the learner acquires only that kind of knowledge which is useful, or may be made so, and that even the knowledge of history and nature is not useful except when mental effort is applied to it. The sorcery of the past was nothing more than the prediction of results which were known to occur from the action of certain effects and forces, which method of reasoning was to-day the basis of all our knowledge and progress.

Later in the afternon of the same day Prof. von Helmholtz, accompanied by Prof. A. G. Bell and Prof. Ogden N. Rood, of Columbia College, proceeded to the Telephone Building, in Cortlandt street, where they were met by Mr. E. J. Hall, and his assistants, of the Long Distance Telephone Co., and were there afforded an opportunity of testing the long distance lines. Conversations passed between Prof. von Helmholtz and Mr. John E. Hudson, president of the American Bell Telephone Co., who was at the Boston end of the line, and music was also transmitted in the circuit extending from New York to Boston and return, a distance of 500 miles. Prof. von Helmholtz also conversed over the Chicago line to the American Bell Telephone exhibit in Electricity Building, at the World's Fair, and also with the German Minister and Prof. S. P. Langely at Washington, both of whom were at the residence of Mr. Gardner G. Hubbard. This was the first experience of Prof. von Helmholtz in long distance telephony and he expressed himself particularly well pleased at the clearness of the conversation, especially that which came over the Chicago line. After the experiments Prof. von Helmholtz was shown over the Telephone Exchange, the equipment of which seemed to interest him very much. Prof. von Helmholtz leaves for Europe this week.

PROFESSOR GEORGE FORBES.

IT is a pleasure to be informed that Prof. George Forbes will maintain a permanent office in New York. He has taken rooms in the Mills Building, 35 Wall street, and will have associated with him Mr. Horatio A. Foster as chief assistant. The many American electricians who have met Prof. Forbes on his several visits to America, all of whom are aware of his ability and attainments, will cordially welcome him as a permanent addition to the ranks of consulting electrical engineers.

PROF. M. M. GARVER.

PROF. M. M. GARVER, who was recently elected to the Chair of Physics in the Pennsylvania State College, was a student and assistant of Prof. Anthony at Cornell during the time the latter was engaged with his early experiments on dynamo construction. After leaving college he entered the electric lighting field as an assistant electrician with Van Depoel in Chicago and later, for several years, with Weston in Newark. He was general manager of the United States Electric Lighting Co., of Philadelphia, from 1884 until the general consolidation of the various electric lighting companies of that city was effected.

In recent years most of his time has been devoted to the invention and manufacture of electrical measuring instruments of precision. His skillful labor in this field is embodied in many of the best measuring instruments on the market to-day. Although the electrical industry now loses a valuable worker, yet the State College is to be congratulated upon the addition to its corps of instructors of a man of Mr. Garver's attainments and wide experience in the practical application of the laws of physics.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the meeting of the American Institute of Electrical Engineers held September 20, Mr. D. McFarlan Moore read an interesting paper on "A New Method for Control of Electric Energy." The paper relates especially to the regulation of incandescent lamps by means of the apparatus invented by Mr. Moore and described in THE ELECTRICAL ENGINEER of March 29, 1893. The principle employed is a varying-in-pressure contact in a vacuum produced by a variable magnetic field, and is applicable to both direct and alternating currents. The author stated his belief that the solution of many other problems might be effected by the same means.

LEGAL NOTES.

THE UNITED STATES ELECTRIC LIGHTING COMPANY vs. THE EDISON LAMP COMPANY.

THE UNITED STATES COMPANY appealed from the decision of the Circuit Court, District of New Jersey, of June 21, 1892 [see the opinion of Judge Acheson in THE ELECTRICAL ENGINEER, No. 217, June 29, 1892]. The suit was for infringement of the Weston patent for building up carbon filaments by heating them electrically while surrounded by a carbonaceous substance.

Argument on the appeal was commenced in the Circuit Court of Appeals, before Judges Dallas and Butler, Monday, October 2, and was concluded Wednesday, October 4.

Thomas B. Kerr, of New York, and George H. Christy, of Pittsburgh, appeared for the United States Electric Lighting Company, and Frederick H. Betts, of New York, for the Edison Lamp Company. Decision was reserved.

EDISON vs. THE ILLINOIS AND SUNBEAM COMPANIES.

A FINAL decree has been entered by Judge Grosscup in each of the suits brought by the Edison Electric Light Company against the Illinois Electric Lamp Company and the Sunbeam Incandescent Lamp Company for an injunction and accounting. The decree in each case establishes the validity of the patent granted Thomas A. Edison in January, 1880, for the improvement of electric lamps. It further gives the complainant nominal damages and a perpetual injunction. Defendants were makers and users of incandescent lamps, which the complainant corporation claimed were in infringement of the Edison patent. In reply to the bill filed by the Edison interests the defendants filed answers calling in question the validity of the Edison patent and citing a number of authorities to show that it had been anticipated elsewhere.

SALE OF WORLD'S FAIR APPARATUS.

MR. C. R. HUNTLEY, of Buffalo, has purchased for the New Lighting Company, at Niagara, N. Y., one of the No. 8, 65-light, 2,000 c. p., arc dynamos comprising the service plant of the Brush Company in Machinery Hall, to be delivered at the close of the Exposition. This leaves but one of the 16 dynamos unsold. There will also accompany the dynamos 60 of the double carbon Brush-Adams lamps which are now doing duty on the "all night" circuit at the Fair. The Indianapolis Light and Power Company, have placed an additional order for 100 double carbon lamps which makes 856 which they have bought within eight months. These, taken in conjunction with the 15 65-light dynamos which they have purchased during the same period show their appreciation of the Brush system.

LETTERS TO THE EDITOR.

POWER TRANSMISSION IN CALIFORNIA.

AN editorial in THE ELECTRICAL ENGINEER of Sept. 20, refers to a statement concerning the failure of long distance transmission of power electrically in California. The original statement was: "In California the electric transmission of power for multifarious purposes is a failure from the standpoint of the investor."

One basis for the statement is the following: Early in 1892 one of the electric manufacturing companies sent a most capable engineer to California to look up transmission schemes. The engineer closed a contract for a single-phase system to transmit about 180 h. p. 18 miles for the purpose of operating the machinery in connection with a mine. This system was selected on account of the success of the *initial* plant established at Telluride, Colorado. The plant was to be installed and in operation by Nov., 1892. The shipment of machinery was delayed so long that the winter snows prevented its transportation to the vicinity of the mine and it was finally set in operation in July of this year.

After thirteen days of indifferent operation the generator broke down, the field coils being burnt out; and certain other accidents, which might easily have been avoided, also occurred.

This plant was in this condition at the time of the Electrical Congress. It was certainly regarded as a failure by its purchaser. Two other mining companies in the same vicinity were desirous of buying electric machinery, but after inspection of the plant decided the system was a failure. A new set of field coils was sent out and the plant again started a few days ago. It is not yet in successful operation, and in a few weeks the power house will be inaccessible until next spring.

The broad statement concerning *failure* was made advisedly to emphasize the statement that followed to the effect that the entire system of machinery for long distance transmission of power can not be perfected in the shops. It must be studied by capable engineers under the actual circumstances which it must meet. In this case the electric company sent a capable engineer to secure the contract for the plant, but sent a subordinate to superintend its installation. The result is serious damage to the interests of the company and a great weakening of confidence on the part of possible investors. Investigation has shown that there is no inherent fault with the system employed and the failure may be traced directly to a lack of care in the supervision of the construction of the plant. Should this plant fail to operate successfully during the coming winter, it will hardly be worth while to talk about electric machinery in that section of California for some years to come. It is a matter of general surprise that the managers of a large electric company should have shown so short-sighted a policy as to allow any chance of even temporary failure to occur in this, the first plant for power transmission in California. I am glad to state that a multiphase plant in Southern California promises to be a success *ab initio*. A capable engineer has been sent to stay with it until its success is absolutely assured.

It would appear that the electric companies have been overwhelmed with the magnitude of the Niagara project. It is really a trivial matter when compared with the possibilities of the Pacific Coast. Although the unqualified statement of *failure* does not quite represent what I said, I do not think I can blame you for that. When I remember the shrieks of the Illinois Central trains in the vicinity—or rather in the midst—of the Congress, I am astonished that anything intelligible was heard. That the proceedings were correctly reported appears miraculous.

Yours very truly,

W. F. C. HASSON.

SAN FRANCISCO, Sept. 27, 1893.

MULTIPHASE MOTOR AND POWER TRANSMISSION.

PERMIT me to correct one of my statements in the discussion on the "Multiphase Motor and Power Transmission" at the International Electrical Congress in Chicago, which discussion has been reported in the issue of Oct. 4, of your esteemed paper. The statement on page 306 ought to read:

"Now, taking up the question of Dr. Duncan, I will state that if the load in the alternating circuit consists of translating devices without self-induction, and if also the field magnets of the motor are properly laminated, the electrical energy that can be transmitted through such a rotary transformer, *is* 180 *per cent.* taking its ordinary mechanical output as a motor, as 100 per cent. The lamination of the field poles I consider not absolutely necessary, but expedient to prevent heating of the frame through reaction of armature coils, now practically subdivided in two."

H. LEMP.

LYNN, MASS., Oct. 4, 1893.

LITERATURE.

Patent Office Manual. By George H. Knight. *Boston.* Little, Brown & Co. Law sheep. 8vo. 655 pages. Price, $5.

MR. KNIGHT bears an honored name in the field of patent soliciting, and this book will but cover it with new and added lustre. We can imagine nothing more useful to the profession generally, or to those in particular who practice before the Patent Office. There is a very interesting introduction on the "patent franchise," with an account of the manner in which, since 1836, the office at Washington has sought not merely to give a man a patent because he asks for it, but to refuse him one if it can in any way discover that the idea or method is old. Up to that time, the presumption acted upon was that the intending patentee was innocent; now it seems to be taken for granted that he can be proved guilty of plagiarism or infringement if the examiner will only work hard enough on the case. But the process is sound and fair. Nobody should secure this valuable "patent franchise" without a good right to it, and the Patent Office might even now increase the rigors of its procedure as to granting patents with real benefit to actual inventors and with material gain to the public, which has a confused notion that the leading men in any field of work do not invent for the pleasure of inventing but because they want to get something to litigate over.

Be that as it may, a handbook such as this must greatly simplify and economize the labor of obtaining a good patent or of frustrating an attempt to lessen its genuine scope; and there is every indication that Mr. Knight has done his work most exhaustively and conscientiously. He begins at the beginning and presents with each topic or heading a statement of the law and the procedure, supported by references to the decisions of the office and of the courts.

The volume closes with chapters on designs, labels, trademarks and copyrights.

Drum Armatures and Commutators; Theory and Practice. By F. Marten Weymouth. *London.* The *Electrician* Printing and Publishing Co., Ltd. Cloth. 294 pages, 162 illustrations. Price 7 shillings and 6 pence.

THIS book is based upon articles that appeared in the London *Electrician* some time ago, and that are certainly worthy of preservation in this convenient form. These articles constitute a very full discussion of the theory of drum winding and take up seriatim the many varieties and changes that have come into fashion. A large portion of the book is then given up to commutators, which like the poor, are always with us, and by reason of their general poverty of design and construction give no end of trouble. As Mr. Weymouth points out, it is a great mistake to suppose that a first-class commutator can be "tossed off" at random, or by chance. Yet it happens sometimes that the commutating end is left to take care of itself or that an ingenious winding will be associated with a highly disreputable commutator; and the union soon ends in disaster. In this book the subject is gone into very thoroughly, and many pertinent topics are touched on in detail, the subject of sparking being discussed under every aspect. Taken as a whole, the volume is an admirable addition to the series that our English contemporary is gradually compiling from its well-filled columns.

BETTER TIMES.

THE CARD ELECTRIC MOTOR CO., of Cincinnati, report brighter prospects after the period of financial depression, that seem to indicate better times in their part of the country at least. They have just completed the installation of two 45 k. w. direct current dynamos of their manufacture, and after a very severe test have received the very highest testimonials as to their efficiency and economy in operating. They have also installed in the Levy Bros'. new building in Louisville, Ky., two 18 k. w. dynamos and have also received from them a high testimonial as to the satisfaction these machines are giving. An 18 k. w. dynamo at the Quick Meal Stove Co., of St. Louis, Mo., and a 25 h. p. motor in the large manufacturing establishment of the Smith & Davis Manufacturing Co., of St. Louis, have also recently been put in. They are now completing an electric light and power plant for the Cincinnati Abattoir Co., of that city, to consist of a 45 k. w. generator, one 25 h. p. and several smaller motors, together with the wiring for 300 incandescent and four arc lamps.

THE WOLVERTON LAMP.

A SITE has been purchased in White Plains by the Wolverton Glow Arc Electric Light Company of New York City, for the erection of their manufacturing shops. This is at the corner of Independence and Liberty streets, Vivian Heights.

A SUBSCRIBER wishes to learn the name of some company or firm from whom he can get a slide rest for turning down commutators.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED SEPTEMBER 26, 1893.

Accumulators :—

Secondary Battery, I. Kitsee, Philadelphia, Pa., 505,467. Filed May 23, 1892.
Employs an electrode of non-conducting material supporting a plurality of conductors extending through the support and having no metallic connection with each other outside the non-conducting material.

Alarms and Signals :—

Means for Preventing Railroad Collisions, E. M. De Monte and C. Jost, Bombay, India, 505,669. Filed Oct. 28, 1892.
An automatic electric block signal system for steam railways.

Dynamos and Motors :—

Multiphase Motor, L. Bell, Boston, Mass., 505,505. Filed June 14, 1893.
Claim 1 follows:
In an electric motor of the inductive type the combination with a revolving secondary member normally closed circuited through a resistance moving therewith, of means for varying the resistance.

Field Magnet Core for Dynamos or Motors, G. S. Strong, New York, N. Y., 505,539. Filed Feb. 3, 1892.
Claim 1 follows:
A field magnet core for dynamos and electric motors having an elongated form with two salient poles on each of its shorter sides and a consequent pole on each of its longer sides.

Controlling Device for Electric Motors, C. G. Curtis, New York, N. Y., 505,594 Filed Oct. 22, 1892.
Provides a switch by which two or more members may be connected in multiple arc or series, and means for locking the switch against operation except when the current is shut off by a circuit-making and breaking device.

Dynamo-Electric Machine, A. S. Atwater, Cleveland, Ohio, 505,622. Filed Jan. 23, 1893.
Employs a duplex commutator made in duplicate taper sections each provided with a terminal semi-annular flange and an insulated clamping ring, in combination with radial brushes bearing upon the outer faces of the sections and flanges.

Dynamo-Electric Machine or Electric Motor, R. Lundell, Brooklyn, N. Y., 505,665. Filed Oct. 31, 1892.
Relates especially to brush-holding apparatus for dynamos and motors.

Armature for Electric Motors, W. J. Sherwood, Ashtabula, Ohio, 505,720. Filed April 16, 1891.
Relates to the mechanical construction of the armature with special reference to ventilation.

Electric Motor, R. Ashley, Philadelphia, Pa., 505,783. Filed May 20, 1893.
Employs an armature core having a series of parallel L shaped teeth on which the coils are wound.

Miscellaneous :—

Electrical Connection, W. L. Smith, Memphis, Tenn., 505,561. Filed April 19, 1892.
Designed for use in connection with electro-medical apparatus.

Method for Depositing Layers of Metal on Glass, J. H. Scharling, Newark, N. J., 505,576. Filed March 30, 1892.

Railways and Appliances :—

Trolley Wire Support, L. T. Gibbs, Milwaukee, Wis., 505,457. Filed Oct. 15, 1892.
A spring support adapted for use under bridges and other solid structures.

Closed Conduit for Electric Railways, G. W. McNear, Oakland, Cal., 505,605. Filed August 1, 1892.
The conductor is confined within a collapsible insulating envelope which carries a series of contact pieces making connection when pressed by the trolley.

Controller Roller for Electric Cars, E. P. Warner, Chicago, Ill., 505,686. Filed June 21, 1892.
Designed especially to prevent sparking between adjacent conducting strips of the controller.

Telephones and Apparatus :—

Duplex Telephony, W. Marshall, New York, N. Y., 505,698. Filed Feb. 28, 1892.
Has for its object the transmission of speech and telegraphic signals over the same wire independently of one another by means of an induced current.

Telephone Circuit, T. Spencer, Cambridge, Mass., 505,730. Filed Feb. 20, 1893.
Employs an induction coil having its primary helix in a branch forming a shunt circuit around the transmitter and its secondary helix in a like branch forming a shunt around the primary, both shunts being of high resistance relatively to the transmitter, so that the greater part of the normal current is directed through the transmitter.

Manufacture of Cables for Multiple Switchboards, O. A. Bell, Brooklyn, N. Y., 505,798. Filed Nov. 7, 1892.
The invention consists in a method of taking out the wires from the separate cables to form a continuous cable with projecting wires at intervals corresponding to the strips of the spring jack switches.

PATENT NOTES.

MARSH'S IMPROVEMENTS IN PAPER CABLES.

A COUPLE of patents have recently been granted to J. W. Marsh, of Pittsburgh, on improvements in the method of applying paper insulation to cables. In one of these the flexibility of the cable and insulation is assisted by providing next the conductor a cushion, upon which the paper is either wound or molded. The cushion consists of fibre of a soft and loose nature, saturated with compound if the cable is for electric lighting purposes and unsaturated for telephone work, where liberal air space is desirable.

The other patent relates to the forming upon the conductor of a covering of paper pulp. This molded form is provided with air spaces, either in the outer surface of the covering or within the covering, or both, and as a general thing extending longitudinally. These spaces admit of air or gas insulation with the aid of which to reduce the static capacity of the cable or single conductor.

THE SCRIBNER ARC LAMP PATENT SUSTAINED.

THE WESTERN ELECTRIC COMPANY, some three years and a half ago, brought suit against the Sperry Electric Company for infringement of patent No. 420,109, of January 28, 1890. The application for the Scribner patent was pending in the Patent Office for more than seven years, and Judge Gresham in the court below held that the application had been abandoned in the Patent Office. The Circuit Court of Appeals of the Seventh Circuit, on October 2, 1893, reversed this finding of Judge Gresham.

It appears that Scribner was the first to invent a swinging or movable frame supporting the coarse wire magnet, that is, the lifting magnet of an arc lamp, which frame was adapted to be controlled by the fine wire magnet placed in the shunt around the arc, thus controlling the feeding of the carbons by controlling the movement of the frame and thereby the clutch. Scribner's first claim describes his invention as follows:

"In an electric arc lamp, the combination, with an electromagnet in the shunt of the arc and its armature, of an electromagnet in the main circuit and its armature, said electromagnet in the main circuit being carried upon a movable support, said support being controlled by the armature of the electromagnet in the shunt of the arc, whereby the position of the main circuit electromagnet and its armature is caused to vary in response to the variations in the strength of the current passing through the electromagnet in the shunt of the arc."

The defendant, the Sperry Electric Company, manufactured the lamp which was held to be an infringement, under letters patent No. 405,440, to Elmer A. Sperry, of June 18, 1889, which had been applied for and issued while the application for the Scribner patent was pending in the Patent Office. This Sperry lamp contained the same combination of parts found in the Scribner patent, but quite differently arranged.

Judge Woods, speaking for the court, says:

"There is a material difference between the abandonment of an invention and the abandonment of an application for letters patent thereon by failure to comply with Section 4,894 of the Revised Statutes. The first gives the invention to the public, and once done, the act is irretrievable; but, besides the power conferred upon the Commissioner of Patents to relieve an applicant from an abandonment of his application under the statute, an application, which has lapsed or been rejected or withdrawn, may be renewed or repeated so long, we suppose, as the invention itself has not been abandoned by reason of a two years' public use or otherwise."

After reviewing authorities at length the Court says:

"Guided as we must be by these decisions, we are not able to find in the present case an abandonment either of the invention or of the application for the patent. The final decision of the Patent Office was that there had been no such delay in the prosecution of the claim as to work a forfeiture of the application, and, even if we had the power to do it, we are not required to review that decision, because the answer in the case does not raise the question,—the abandonment alleged being of the invention, and not of the application for the patent. It is true that the respondents denied any information or belief whether 'the letters patent referred to in the bill of complaint were issued in due form of law,' and asked for strict proof of that and of other averments not admitted; but the facts touching the prosecution of the application were matters of record in the Patent Office, easily accessible if not known already, and if the respondents proposed to tender an issue of abondonment, it was necessary to do it by averments to that effect, specific and clear enough to be understood."

After this follows a close analysis of the Scribner invention and of the Sperry lamp in connection with the prior art, and the opinion concludes as follows:

"But the magnetic current itself is not a part of the device any more than is water an element of a water wheel. In one case water is the power and in the other the electric current, and the devices are contrived for the purpose of controlling and applying the power. The invention is in the device, which may have one, two, or more functions, one of great and another of trifling worth. It may be supposed to have a function which it has not. The patent is upon the device, and not upon the functions, real or supposed, and if the device is appropriated in its essential features, it will be an infringement, notwithstanding some change in the location and relation of parts, whereby a doubtful function of little comparative worth is eliminated. At first, Scribner, it is clear, believed the up-and-down compensating movement of the armature in the main circuit, irrespective of the action of the regulating magnet, to be an important feature of his lamp, but before the patent issued, without changing the drawing or modifying the structure of his device in the least, he presented an amended specification in which he repudiated that idea, and described the armature in operation as assuming and holding a definite relation to the magnet. So long as he did not change the structure of his device or invention, he had the right to change the specification, even though he did it with reference to the Sperry patent, which was applied for and issued while his application was on file; and, the specification being as we find it, there is no support for the proposition that for the purpose of preserving the possibility of a function, which the patentee had repudiated before the patent issued, the claims, though worded differently, should be so read as to cover only the exact construction and relation of parts illustrated in the drawing. The proposition is not reasonable, nor, so far as we know, supported by authority.

"The first claim of the Sperry patent, and other claims not quoted, are essentially the same as the first and second claims of the patent in suit, and the lamp made by the respondents differs in essential elements from the complainant's lamp, only in respect to the relative positions of the main-circuit magnet and its armature, horizontal parts being made vertical and *vice versa.*

"Our conclusion, therefore, is that the patent in suit is valid, that it belongs to the complainant as assignee of the patentee, and that the respondents before suit had infringed the first and second claims thereof as charged."

Barton & Brown appeared for the Western Electric Company, and Francis W. Parker for the Sperry Electric Company.

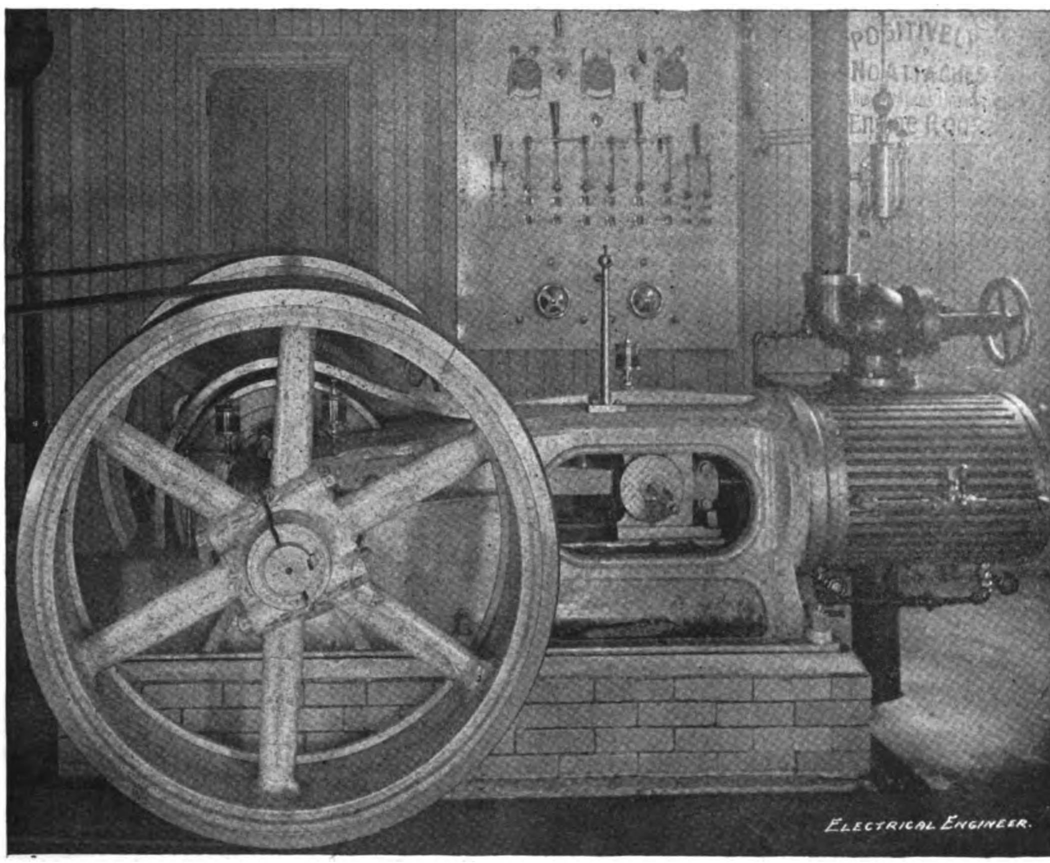
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

LIGHTING A THEATRE IN ALLEGHENY, PA.

The new Palace theatre, of Allegheny, Pa., which was opened on Monday, August 21, possesses one of the most substantial and complete electric lighting plants in Western Pennsylvania. The entire plant was installed by the Austin Engineering Co., of Pittsburgh, and consists of a nominal 80 h. p. centre crank M. A. Green engine, manufactured by the Altoona Manufacturing Co., of Altoona, Pa., for whom the Austin Engineering Co. are the general agents. This engine, shown in the accompanying engraving, is very highly finished in white, gold and blue and presents a remarkably fine appearance from the lobby, at which point it can be seen through the glass partition. The dynamos are of the latest multipolar design from the Western Electric Co., and were purchased through their New York house. They run at a speed of 400 revolutions and have a rated output of 26 k. w. The machines run noiselessly and remain quite cool, and have been the subject of much favorable comment from local electricians. The switchboard, also manufactured by this company, is of white marble, on which are mounted the voltmeter, ammeters and switches, all highly finished and presenting a very ornamental appearance. The stage regulating mechanism is mounted on marbleized slate and all the rheostats are of the Carpenter enamel variety and take up so small a space that it is almost impossible to make the uninitiated believe that they are "all there." The steam plant also includes one 100 h. p. "Economic" boiler, built by the Erie City Iron Works, of Erie, Pa.

The entire plant was installed under the personal supervision of Mr. David W. Dunn, general manager of the Austin Engineering Co., with a view to permanence, and its substantial appearance is ample evidence of his success.



Theatre Lighting Plant at Allegheny, Pa.

TESTING THE ARCS AT MANCHESTER, N. H.

An expert test has been made of the arcs supplied to the city by the Manchester Electric Light Co., when they were all found to be well over 2,000 c. p. In fact, they ran up to 2,110.85 c. p.

LIGHTING THE NEW BOSTON & MAINE DEPOT, BOSTON.

The Boston and Maine Railroad has closed its contract for an extensive power and electrical equipment for the new terminal station in Boston. The plant represents an aggregate capacity of 1,100 h. p. in the engine-room, with corresponding equipment throughout. There are to be four Westinghouse generators coupled direct to Westinghouse compound condensing engines of 200 h. p. each. Two of these generators will supply some 4,000 incandescent lights for the interior service of the building, round house, etc., the other two will furnish power to the various motors operating draw bridges, turn-tables, elevators, coal handling machinery, etc. Besides these, there are two more compound engines, respectively of 200 and 100 h. p., driving alternate current machines for the distant lighting at Prison Point and East Somerville, together with the track lighting and signal towers. Each of these engines exhausts into an independent Bulkley condenser, using salt water. A battery of twelve horizontal return tubular boilers supplies steam at 125 pounds pressure.

A striking feature about this plant will be the system of mechanical draft which takes the place of a chimney 200 feet high, otherwise required. Instead of this a steel stack rising only 55 feet above the ground level delivers the flue gases at a height sufficient to clear the roof. Draft is furnished by two large Sturtevant fans, each driven by a small independent engine, and each capable of performing the whole service when required. The hot flue gases are drawn through Greene economizers and the heat extracted returned to the feed water. Not only will this arrangement secure an increased economy of fuel and place the control of the draft in the hands of an engineer to be manipulated at pleasure, but in this case, it will greatly reduce the first cost below that of an equivalent chimney built upon the piling foundations necessary from the location.

The engineer in charge for the company is Mr. George H. Barrus, and the contract in full was awarded to the Boston office of Westinghouse, Church, Kerr & Co.

MR. S. W. RUSHMORE.

Mr. S. W. Rushmore, who has, for more than a year past, been engaged in repair work for central stations and electric railways, is now employing 15 men overtime rebuilding large Thomson-Houston and Excelsior arc machines. Mr. Rushmore devotes himself exclusively to heavy dynamo work at Morris and Hudson streets, Jersey City, N. J.

MECHANICAL STOKING IN ELECTRICAL WORK.

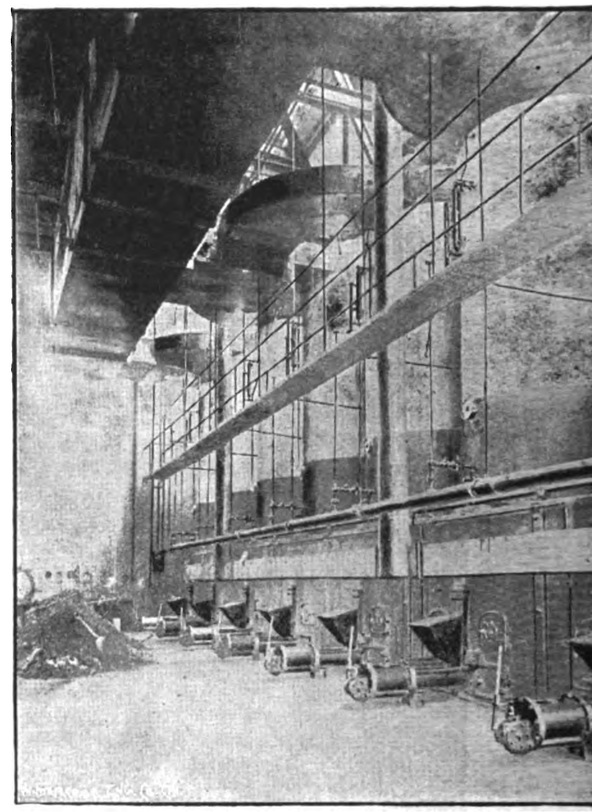
ONE of the most ingenious of the recent devices for burning coal is the Jones underfeed mechanical stoker, which by its name indicates the unique method adopted of introducing the fuel under the fire instead of on top as in ordinary practice. This machine is applicable to any form of boiler. Twenty-six inches of the grate is removed from the centre of the furnace and the retort inserted with its top level with the surface of the grates. The air connections are attached to a blower driven by an independent engine.

Suppose that the furnace is being fired without steam in the boiler. The retort is first filled with coal level with the top of the tuyere pipes. Fire is then started on the side grates as usual until steam is raised. The ash-pit doors that admit air to the side grates are then closed, and the coal is placed in the hopper outside the boiler front; the steam ram is withdrawn by shifting the lever, the desired quantity of coal falls from the hopper in front of the ram, and upon the return stroke of the ram it is forced into the retort. Air under pressure is then admitted into the tuyere pipes. This air issues from the slots shown in the illustration, over the top of the fuel in the retort, but under and through the burning fuel. The result is that the heat from the burning fuel over the retort slowly liberates the gas from the green fuel within. This gas being thoroughly mixed with the incoming air before it passes through the burning fuel above, produces a bright, clear fire, free from smoke, and insures the complete consumption of all the heat-producing elements in the fuel. The retort being practically air-tight from below, and the fuel being in a compact mass, the air will find its way in the direction of the least resistance which is upward; consequently combustion takes place above the air-slots only, and hence the castings of the retort are always cool and not subject to the action of the fire. The incoming fresh fuel from the retort forces the resulting ash and clinker over the top of the tuyere pipes to the side grates, whence they may be removed at any time without in the least interfering with the fire in the centre of the furnace. Since cold air is not admitted by opening the doors for the introduction of fresh fuel, a high even temperature is maintained at all times.

This stoker, first used for firing four-foot wood, was invented by Mr. Evan W. Jones, superintendent of the Union Iron Works, Portland, Oregon, in 1889. Soon after its success as a wood-burner was established it was modified and the same principle applied to the burning of coal. The first plant was placed in the power house of the Portland Cable Railway where very good results were obtained. A gain of more than 20 per cent. is claimed to have been shown over hand-firing.

The largest electric plant equipped with these stokers is that of the Edison Light and Power Company in San Francisco, where twenty-three of these machines are in use. This station has a capacity of 28,000 incandescent lights of 16 c. p., though at present there is only about two-thirds of this number connected. The illustration shows the stoker applied to a battery of seven 240 h. p. Reynolds' upright boilers. This plant is very flexible. By feeding the coal more rapidly and increasing the air pressure it is able to meet any sudden demand for steam, within the capacity of the boilers, very readily.

The Edison Company made a series of tests with the view of finding the most economical fuel for their use in San Francisco. With a mixture of Puget sound bituminous and Cardiff coal in the proportion of one to one they obtained an evaporation of 10.81 pounds of water per pound of coal from and at 212° under actual working conditions, and with intelligent firing have no difficulty in maintaining a steady steam line.

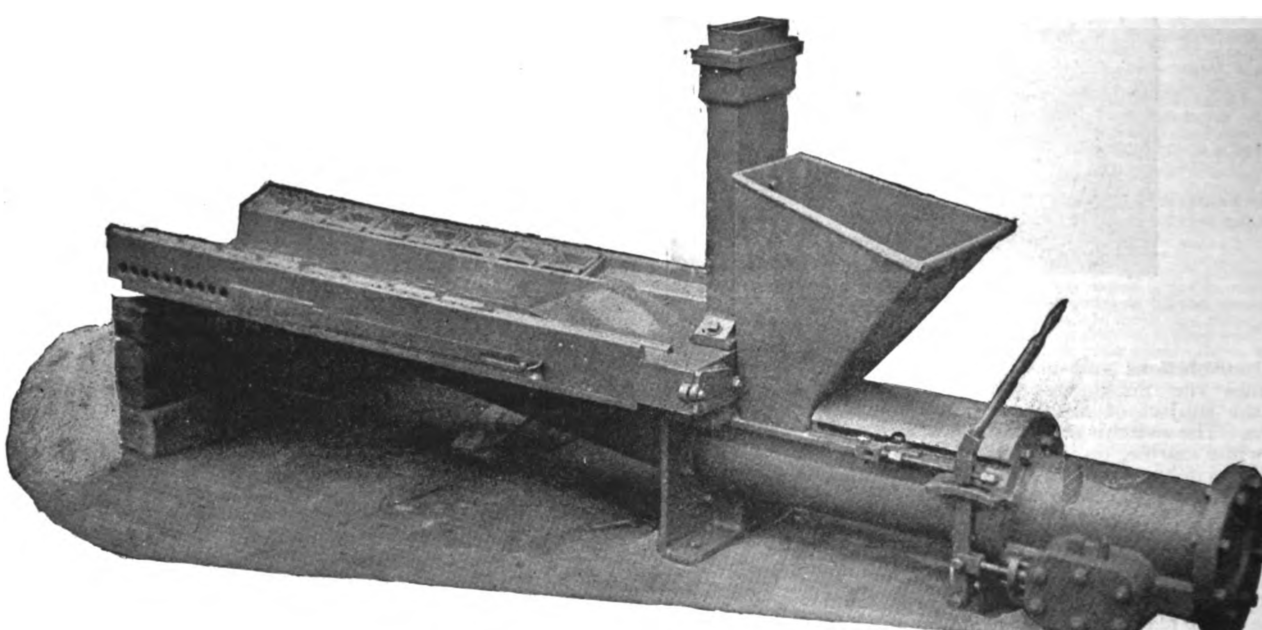


THE JONES MECHANICAL STOKER IN THE EDISON STATION, SAN FRANCISCO, CAL.

The most recently installed stoker in an electric plant is that in the First Cincinnati Edison Electric Company where a net saving of more than 15 per cent. was made, burning "Pittsburgh screenings."

The Jones stoker seems to combine the points of durability, flexibility and economy, judging from the experience of those who are using it for the production of electricity.

Messrs. Garrison and Greer, of 620 Atlantic avenue, Boston, are agents for the device.



THE JONES UNDERFEED MECHANICAL STOKER.

THE BRISTOLS' MANUFACTURING COMPANY'S EXHIBIT OF RECORDING INSTRUMENTS AT THE WORLD'S FAIR.

ONE of the most attractive exhibits in Machinery Hall, Section 25, is that made by the Bristols' Manufacturing Company, of Waterbury, Conn., shown in our engraving, Fig. 1.

Since its establishment in 1889, this company have developed an extensive business with Bristol's recording pressure gauges and steel belt lacing.

Their line of gauges is now very complete, comprising a list of over twenty different ranges from vacuum to 1,500 pounds per square inch and adapted to record continuously day and night, pressures of air, gas, steam, water and liquids.

The corner space occupied is diagonally spanned by an excellent imitation of a stone arch, the facing of fine leather and the stones fastened together with the company's patent steel belt lacing. To each of the stones is attached one of their gold plated recording gauges, every alternate instrument being provided with an electric light. On one pillar supporting the arch is a gauge in operation recording the pressure of steam used in the building. On the other pillar of the arch is one of their new recording voltmeters in operation recording continuously the voltage of the alternating current which supplies the lights. An artistic and ornamental feature is the semi-circular grille of wrought iron which fills in the arch and bears the name of the company and their specialties.

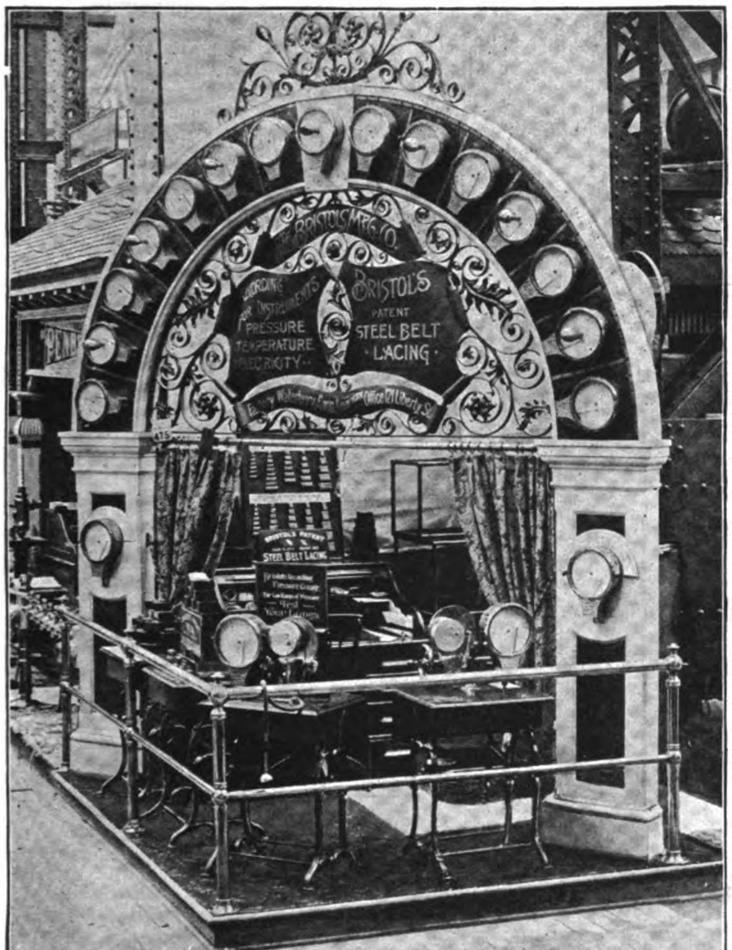


EXHIBIT OF THE BRISTOLS' MFG. CO. MACHINERY HALL.

Models of the different recording instruments are arranged on tables so that the visitors may examine the construction. For the high pressures a hand screw pump is provided, but for low pressures a gauge is fitted with a mouthpiece and each visitor can operate the model by blowing. A new recording thermometer is also shown in operation, but it will not be placed upon the market until their recording pyrometer is ready. A complete line of their patent steel belt lacing, for all kinds of belting is also attractively displayed.

Outside of the exhibit proper, there are eight of Bristol's recording gauges in operation at different points within the Fair grounds.

As the new recording voltmeter for alternating or direct currents has not been previously described, we illustrate the instrument, Fig. 2, complete, ready for connection, and also with the front of case removed, Fig. 3, from which the extremely simple

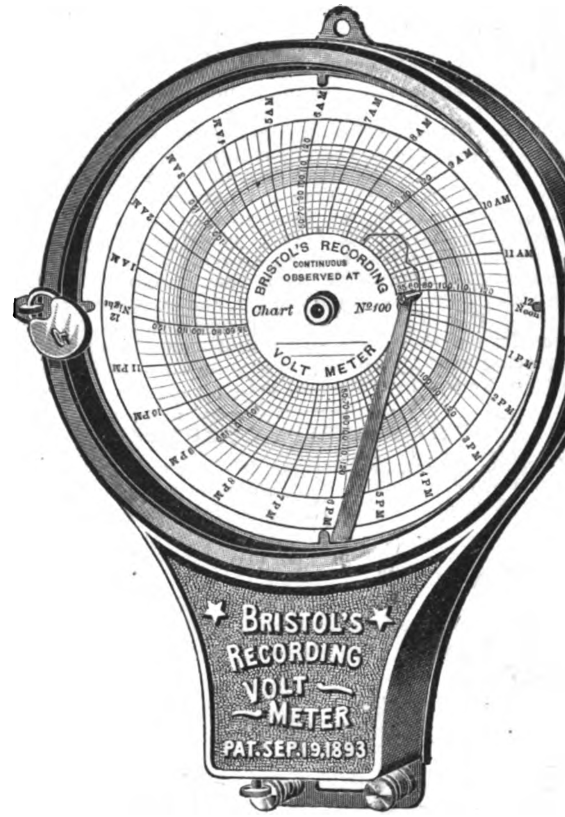


FIG. 2.—THE BRISTOL RECORDING VOLTMETER.

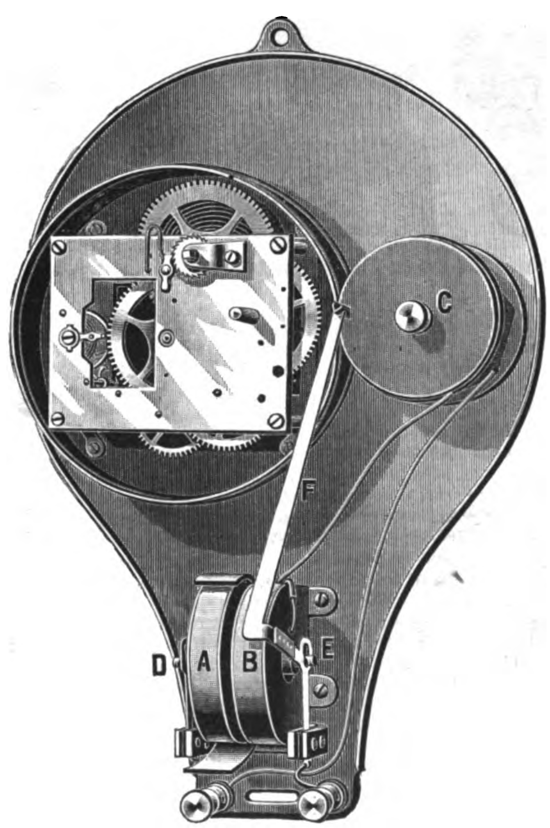


FIG. 3.—THE BRISTOL RECORDING VOLTMETER.

construction and manner of operation will be readily understood.

The coil A is mounted on the spring knife edge supports D and E, and is free to move toward the parallel and stationary coil B, when

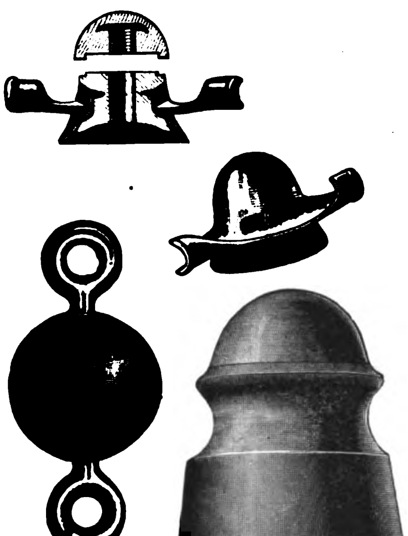
they are mutually attracted to each other by a current passing in series. The current is conducted to the movable coil A, through the supporting springs D and E, and this, together with the special feature of the moving coil being mounted on frictionless spring knife edges, renders the instrument extremely sensitive to the smallest changes of voltage. The marking arm F is attached directly to the spring E and partakes of its motion, recording the changes of voltage on a uniformly revolving chart.

It will be observed that the instrument is constructed on the electric balance principle without permanent magnets. The divisions on the chart are on an increased scale in the vicinity of the voltage to be maintained, thereby making it possible to note the variation of one volt. The chart shown, Fig. 3, is intended for a 110-volt circuit. The coil C is an auxiliary resistance. With the alternating current voltmeter the auxiliary resistance is furnished in a separate rheostat which may be adjusted to suit the rate of alternations of the current to be measured.

Several of the instruments have been in use in large electric light stations for the past three months, and are giving the highest satisfaction. One of the voltmeters is on exhibition in Electricity Building. Two of them, one for alternating and one for direct current, are being used by the Committee on Awards in connection with the life tests of incandescent lamps.

THE FIBERITE COMPANY.

THE accompanying illustrations show four of the 50 or more different styles of line and other insulators made by the Fiberite Company, of Mechanicville, N. Y. These are the Emerson and the Standard straight line hanger, a feed wire insulator and a globe strain.



FIBERITE RAILWAY LINE INSULATORS.

The company have overhauled their selling agencies thoroughly and secured many new ones among the best houses in the country. They are now making perhaps the most extensive assortment of railroad insulating material in the country in many distinct types or styles and are prepared to supply almost any reasonable wants. They have added a large quantity of new machinery and also a brass foundry and machine shop.

The insulating material made by this company is the invention of Mr. J. H. Medbery, the president. It is claimed to be absolutely weatherproof, and to possess the highest insulating properties and greatest strength of any insulating material known. Each piece, moreover, is guaranteed by the makers.

Among the present agencies for this valuable compound are the following: Western Electric Company, New York; Brown Electric Company, Boston; Pepper & Register, Phila., Pa.; F. P. Little Electric Construction and Supply Company, Buffalo, N. Y.; The Electric Construction and Supply Company, Pittsburgh, Pa; Electric Railway Equipment Company. Cincinnati, Ohio; Geo. Cutter, Chicago; Arthur S. Partridge, St. Louis; Wade & Betts, Atlanta; Southern Electric Supply and Construction Company, New Orleans.

CHEERING REPORTS FROM INDIANAPOLIS.

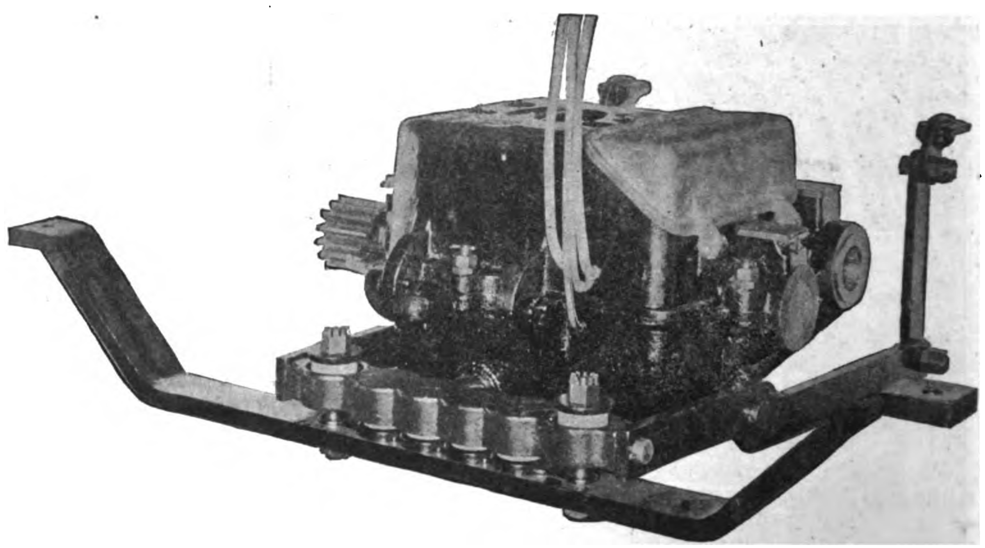
THE INDIANAPOLIS JOURNAL has the following:—The manufacturers of motors, dynamos and other electrical appliances report orders as coming in more freely and are beginning to increase their number of employés. The Jenney Motor Company last week contracted to furnish a 480-light plant to go to Marseilles, Mo., a large motor to go to St. Louis, and has numerous small orders to fill, and feels that from now on the works are to be quite busy.

The Commercial Electric Company has experienced a considerable revival of business during the last few days and reports the following recent orders: City water works plant, Toledo, O., one 35 K. W. dynamo; Northwestern Car and Machine Works, Oshkosh, Wis., one 25 K. W. dynamo; Graham Hotel, New York, N. Y., one 30 K. W. dynamo, besides a considerable number of machines under five horse-power capacity for different points. This company considers the outlook for fall business very encouraging.

A NEW METHOD OF MOTOR SUSPENSION.

AMONG the improvements which the introduction by the General Electric Company of the new "G. E. 800" street car motor has brought into street railway practice, is a new method of suspending the motor on the axle and the truck, whereby it is made to rest upon a resilient system, the weight being supported at a point immediately below the centre of gravity of the motor itself. This system of suspension is known as the cradle suspension and its advantages can be seen by reference to the accompanying illustration.

Immediately below the armature bearings are trunnions on each side of the motor, set in side bars, which are pivotted at the front to a special casting, and supported at the rear end from link bars bolted to the truck frame. The front special casting is mounted upon six springs, two of which offer resistance to pressure upwards, and form resistance to the downward pressure.



THE NEW "G. E. 800" RAILWAY MOTOR SUSPENSION.

It will thus be seen that this modification is of significance in electric railway practice. The motor being set upon a spring-like cushion, the greater part of the dead weight is taken off the axle itself and is more evenly distributed to the axle bearings, and that part of the truck which can better stand the strain. This, in conjunction with the extraordinary lightness of the motor, means economy of track maintenance and a decrease in the possibility of accident to the axles. A series of careful tests have already shown the value of the improvement which promises to become general where the "G. E. 800" is used.

This method will be seen at the Milwaukee Convention, where the street railway engineers will have a good opportunity to examine it.

UTILIZING THE ENOSBURGH FALLS, VT.

THE ENOSBURG FALLS ELECTRIC LIGHT AND POWER CO. has put in a neat little plant of the National Manufacturing Co.'s system, comprising a dynamo and 750 lights of the alternating system. There are three miles of circuit. The machine is run by a Hunt wheel of 116 h. p. under head from the Falls. The power house is of brick and iron. The company, which has a capital stock of $10,000, is officered as follows: H. D. Kendall, president and general manager; C. F. Eldredge, treasurer; F. B. Hobbs, superintendent.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

Electrical Engineer.

Vol. XVI. OCTOBER 18, 1893. No. 285.

THE CHLORIDE ACCUMULATOR.

IT appears strange, indeed, in view of the wide-spread and general employment of storage batteries in central station work in Europe, that so little should have been accomplished in that direction in this country. We have from time to time drawn attention to this fact and pointed out how the efficiency of lighting stations can be normally increased by the addition of a storage battery-plant, which enables the engines to be run continuously at their maximum load and hence at maximum efficiency. The recognition of the benefits to be derived from this method of operation are shown by the large battery plants in use in Paris, where the Popp Company operates no less than 25 sub-stations provided with storage batteries, each with a capacity of from two to three thousand ampere hours, and feeding over 100,000 lamps. The cells employed in this system are manufactured by the Société pour le Travail Electrique des Métaux, whose cells are of the Laurent-Cély chloride type and are in use in scores of stations as well as in private plants all over France. In Germany and England also storage batteries have come into very extensive use as adjuncts to central stations. Thus we may cite those of Hanover with 20,000 lights; Düsseldorf, 20,000; Bamberg, 2,700; Darmstadt, 5,800; Hamburg, 12,000; Elberfeld, 14,000, and many more.

After a thorough investigation of the chloride cell and its workings abroad Mr. W. W. Gibbs, president of the

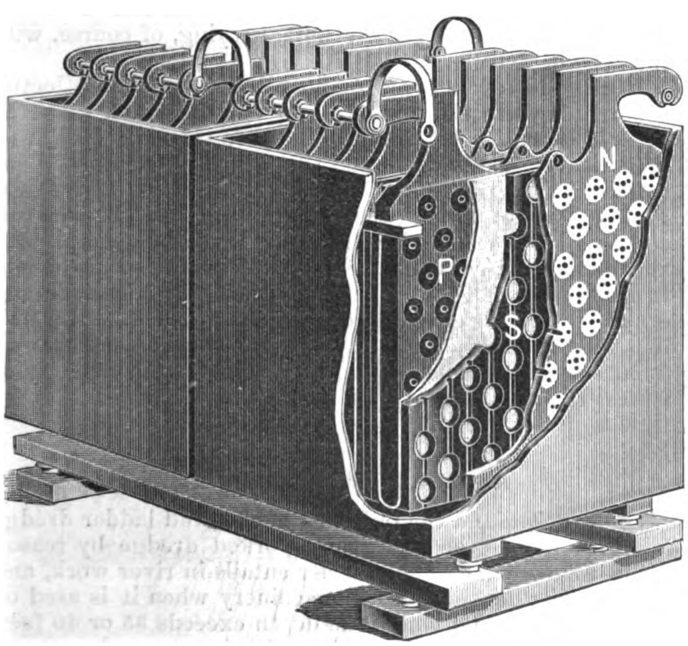


FIG. 1.—THE CHLORIDE ACCUMULATOR.

Electric Storage Battery Company, of Philadelphia, determined to introduce it in this country and work was begun at the factory of the company at Gloucester, N. J.

The battery derives its name from the fact that the plates constituting the elements are made up of tablets cast from fused chloride of lead and zinc, which are held rigidly by a frame of antimonious lead. When so cast, however, they are not ready to be used, as the material in this condition is unfit to become active in a secondary battery. To make the plates active a chemical change is

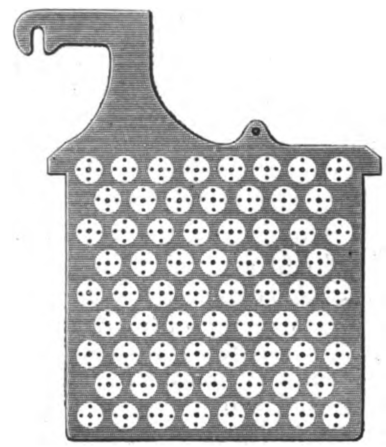


FIG. 2.—CHLORIDE ACCUMULATOR PLATE.

effected in the chloride tablets by means of a bath of chloride of zinc, in which the plates are immersed in connection with a slab of metallic zinc. The arrangement forms, in fact, a primary battery, the zinc acting as a positive and the tablets as a negative element. The electro-chemical action which results draws the chloride of zinc from the tablets by simple solution in the bath and also withdraws the chlorine from the chloride of lead and fixes it with the zinc, forming chloride of zinc. The latter is then washed out of the plate, leaving the mass of crystallized metallic lead, which is immediately available as active material in a storage battery.

It may be interesting here to refer briefly, also, to the method employed in obtaining the material required in the formation of the tablets. The lead distined for the formation of chloride of lead is brought to a state of very fine subdivision by heating it to fusion, and blowing it into a fine powder by means of a jet of dry steam. This powder is then shoveled into earthenware baskets suspended in large tanks of dilute nitric acid. The nitrate of lead solution thus formed is run off into precipitating tanks, where, on an addition of hydrochloride acid, the chloride of lead is thrown down in a fine white powder, nitric acid being set free. The chloride of lead so produced is then mixed with a proper proportion of chloride of zinc and both melted together in the form of a tablet. These tablets then have the molten alloy forced around them under heavy pressure, forming a dense metallic frame, which makes perfect contact with the tablets. The latter on account of their peculiar dovetailed form are held securely in place, the dovetail being V-shaped inwardly so that the diameter of the tablet is greater at the centre than at the edges.

The reduction process extends over a period varying from twelve to twenty-four hours. Every trace of chlorine is finally removed by washing in running water. The plates are then charged continuously for several weeks

until the crystalline spongy lead has been completely converted into peroxide.

The theoretical amount of current required to form a pound of peroxide of lead is about 200 ampere hours and practice shows that this figure is very nearly attained in the present case, owing to the extremely porous structure.

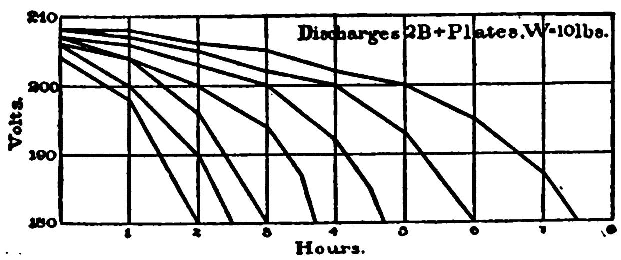


FIG. 3.

The chloride of zinc, it will be noted, performs two offices. In the first place it permits of casting the tablets, for, without it they would fall to pieces. Secondly, it permits of controlling the density of the tablet so that any desired porosity can be obtained, a feature of considerable importance, as upon this point largely depends the expansion of the plate.

Our engraving, Fig. 1, shows the chloride cell as now constructed. As will be seen, it consists of a negative plate with round tablets of active material, which are perforated in order to permit of the free circulation of the battery fluid. The negative is separated from the positive plate P, first by a separator S, made of wood soaked in insulating compound and perforated to correspond with the location of the tablets in the plate. The perforations, it will be noted, are also connected by vertical grooves which permit of the circulation of the liquid, and also allow any gas which may be generated to escape. The positive plate, which is made considerably heavier than the negative, is surrounded by asbestos cloth which prevents any active material which may become loose from falling out and causing short circuits between the plates. The asbestos cloth, it will be noted, encircles the bottom of the plates as well as the sides so that no material can fall to the bottom Fig. 2 shows the plate complete in perspective.

The capacity of the chloride cells is from 5 to 6 ampere hours per pound, with a discharge rate of $\frac{1}{2}$ ampere for each pound of plate—a very high rate. Notwithstanding this high capacity and high rate of discharge the efficiency of the cell is very high, the loss in current being less than 10 per cent. and of watt efficiency from 75 to 85 per cent. The diagram, Fig. 3, shows the decrease in

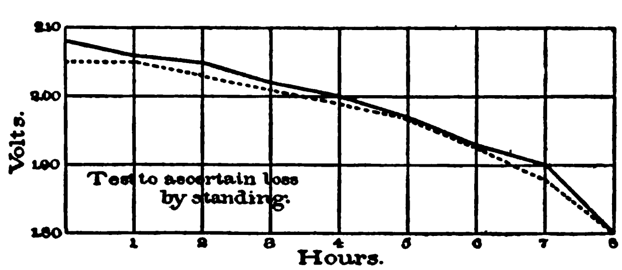


FIG. 4.

capacity as the rate increases, the lowest discharge being at the rate of $\frac{3}{4}$ ampere per pound of plate, and the highest at the rate of two amperes per pound. Thus an increase in rate of 250 per cent. decreased the capacity only 33 per cent. As showing the slight loss by allowing the cell to stand charged, the upper curve, Fig. 4, shows the discharge taken immediately after charge and the lower one after the cell has been allowed to stand charged 24 hours. Fig. 5 is a curve of discharge at the rate of $\frac{3}{5}$ ampere per pound. It will be noted that more than $\frac{2}{3}$ of the capacity was obtained above 2 volts, and experiments have shown that at the rate of $\frac{1}{2}$ ampere over $\frac{3}{4}$ of the capacity is obtained above 2 volts. For electric traction work this feature is evidently a very valuable one.

A large plant of chloride cells having a capacity of 1,894 ampere hours has been placed in the Provident Life and Trust Company's Building in Philadelphia, which, on a recent test exceeded by nearly 50 per cent. the guarantee given by the company. The chloride battery plant in connection with the Germantown, Pa., electric lighting station, having a capacity of 1,000 ampere hours, which has been in operation for some time, will soon be increased to double this amount.

In addition to its employment for lighting, an equally large field is open to the storage battery for traction work, both as applied directly to the car and as an auxiliary to railway power stations. Thus two sets of chloride batteries of 96 cells each have been in use on the Metropolitan Railway, at Washington since last April. The car has run 8,000 miles, and on one occasion was kept on the road continuously for three days; and thus far the batteries have remained unchanged. We may add here that the Laurent-Cély chloride cells have been employed on the Paris tramways for nearly two years past.

Following the method generally adopted abroad the company has determined to guarantee and maintain the cells employed in lighting stations at an annual charge of 10 per cent. on the first cost, it being understood, of course, that the cells are worked under normal conditions. For

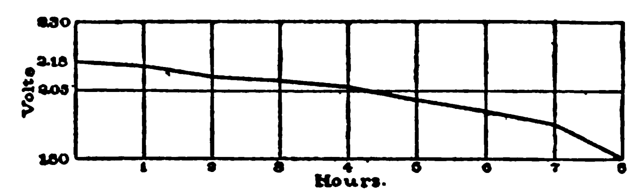


FIG. 5.

railway traction work they propose to maintain batteries for a definite charge per car mile, varying, of course, with the type of road.

It may be of interest to note here that the Electric Storage Battery Co. are working in connection with the Chloride Electrical Storage Syndicate (Mather & Platt), of Manchester, England, and the Société Anonyme Pour le Travail Electrique des Métaux (Rothschilds), of Paris, France, both of which concerns manufacture this type of cell on a large scale. Mr. Herbert Lloyd, the general manager of the company, has been actively engaged in the perfection of the cell for the last five years, and so thoroughly convinced are his company of the quality of their battery that they are now erecting a new factory near Germantown Junction, which, when completed, will have a capacity of no less than ten tons of plates per day.

AN ELECTRICAL DREDGE.

IN New Zealand the ordinary bucket and ladder dredge is giving way to the electrically-worked dredge by reason of the heavy expense the former entails in river work, and the necessity for ponderous machinery when it is used on rocky bottoms, and where the depth exceeds 35 or 40 feet. The plant is remarkably simple, and it is proposed to spend $2,700 upon the same amount of work as formerly cost $8,000, besides having more time to give to paying work in consequence of the reduction in the amount of necessary repairs. Engineers are beginning to realize the amount that can be saved in one year by the work of the electrical dredge, and that the work can at the same time be better done than by the style of apparatus now in use.

ELECTRIC RAILWAY DEPARTMENT.

THE EVOLUTION OF AN ELECTRIC ROAD.— ST. CATHARINES, CANADA.

BY

T. C. Martin

I.

HE contrast between old and new methods is not often so strikingly presented as it can be found in electrical work, where changes are rapid and extreme. This fact was borne in upon me when, visiting Niagara Falls to inspect and describe the magnificent trolley road that borders the Canadian shore for twelve miles,[1] I discovered that at St. Catharines, near by, the street railway was still being operated with pioneer Van Depoele apparatus, and had overrunning trolleys on double overhead circuits, entirely independent of the track. Through the courtesy of Mr. Frederic Nicholls, of the Canadian General Electric Co., I was enabled to visit the old road and to see it just before the transition, with which he has been entrusted, is made to modern plant and methods. I brought away with me one of the antique trolleys as a relic, and have made it useful, for the last time, in employing it as an initial for this article.

It occurred to me then that some notes on the evolution of this road would prove of interest to the readers of this journal, and with the help of Mr. H. D. Symmes, one of the present proprietors, I am now able to submit a few details. I am also under obligations to Miss Annie Larkin, a charming young amateur photographer, for a beautiful set of views of the road and cars. Four of these photographs illustrate this article.

II.

It was in the winter of 1886–7 that Mr. C. A. Smith, as president and manager of the St. Catharines, Merrillton and Thorold Street Railway, a horse road started in 1879, became convinced that the merits of electricity for traction, which a few of us were so insistent and enthusiastic about, must be looked into. But when he invited manufacturers to equip him for operating on the steep grades and short curves of his road, they did not hanker after the contract, and Hobson's choice was found in the Van Depoele Co., of Chicago. Those were days when Gen. Stiles and Mr. C. J. Van Depoele were begging for a chance anywhere to show what they could do, and they soon filled up Mr. Smith with their own high faith in electricity. The road was actually put in commercial operation electrically in the Fall of 1887.

THE POWER HOUSE.

At first the road was very successful and paid good dividends, but it fell on evil days, was allowed to run down, and would have passed out of existence, after a couple of auction sales of the property, had not a happy turn in its vicissitudinous career put it into the energetic hands of Messrs. Dawson & Symmes, the contractors for the Chignecto Ship Railway, who have since organized it anew as the Port Dalhousie, St. Catharines & Thorold Electric Street Railway. The present management impresses me as most energetic and intelligent, and likely to make a very brilliant success of the renovated and extended system.

A CHEERFUL WINTER SCENE.

The prime energy of the road has always been water, and the power house is situated at lock 12, on the original Welland Canal. A 500-volt generator of 100 h. p. with a 220-volt exciter, was put in; and I may note that the cost for this was $4,000. Down almost to the present moment, the only safety device was a switch so arranged that the exciter might be short circuited in case of a short circuit on the main line. Such episodes were by no means infrequent, as it was a source of pleasure and instruction to the guileless local folk to drop crowbars across the two overhead wires. Another fund of amusement was derived from putting wire across, when the current was temporarily off, and watching the electrical illumination of the Province of Ontario when the current came on again.

The motors were fondly supposed by the builders to be of 20 and 25 h. p. respectively, but the difference, in actual operation, literally simmered down to a difference in the thickness of the field insulation. The speed of the motors was controlled both by a rheostat and by commutating the fields. Some of these old motors are still in use there. In the two fields on each motor are 15,000 feet of No. 11 B. & S. wire arranged to give eight steps of resistance; and in the armature are 48 sections of 75 feet each of the same size of wire as the fields.

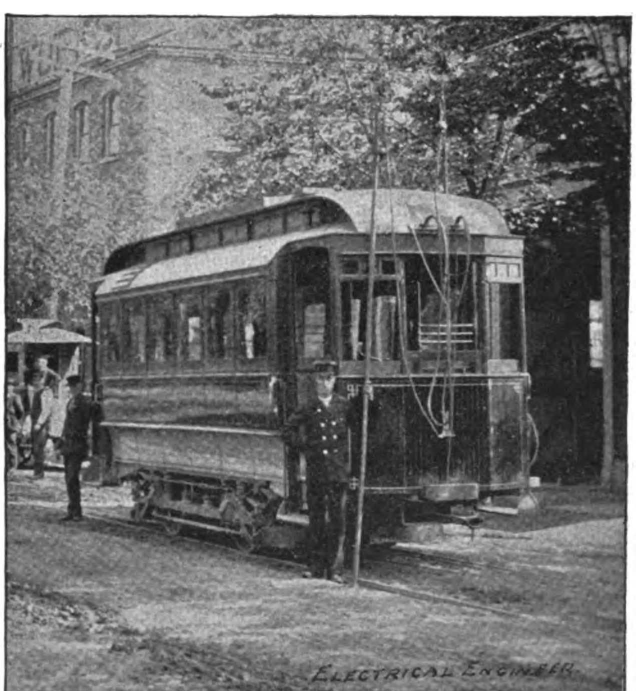
The brushes used are peculiar, consisting of two pieces of brass rivetted together, with a space left between the ends, which are turned up to receive a piece of electric light carbon. As the copper was never scraped off the carbon, the noise made by the grinding on the commutator was anything but a song of the sirens.

1 See THE ELECTRICAL ENGINEER, Aug. 9, 1893.

The motors were placed on the front of the car, and the wheels were put well forward, so that the weight of the car behind the front wheels would balance the weight of the motor. I remember once being induced by Mr. Van Depoele to jump up and down violently, with two or three other friends, on the rear platform of one of his cars of this type, to illustrate his statement that they would not tip. The motorman sat on the commutator side of his motor, in a neat little cab, and no one was allowed to speak to the man at the wheel unless that man undertook also the duties of conductor.

Turntables were provided at the ends of the line, as the cars then ran in one direction only. Mr. Symmes very neatly describes their motion, then running at 20 miles an hour with a light load, as resembling that of a snipe which haunts the Canadian frog ponds. The power from the motor to car axle was transmitted by a pinion driving a spur gear having at each end a sprocket wheel 10 inches in diameter. These sprockets were connected by chains with two 20-inch sprockets on the front axle. Probably Mr. Van Depoele experimented as much with improvements on the sprockets and links as he did on trolleys. When a section in the motor armature burned out or an open circuit occurred, the section in trouble was nonchalantly cut out and the commutator bars were connected across with fine wire. Some of these cripples would run thus and stand up to their work for months, with 6 or 7 sections cut out. Mr. Symmes informs me that the first motor supplied was the best, and that it was in constant service until last March, when the car and its motor were both destroyed by fire.

During its earlier history, the road had four box and three open cars equipped with Van Depoele motors. It still has two Van Depoele motors on open cars, in active use, but the equipment has been increased by new rolling stock with Thomson-Houston "W. P. 50" motors, and by

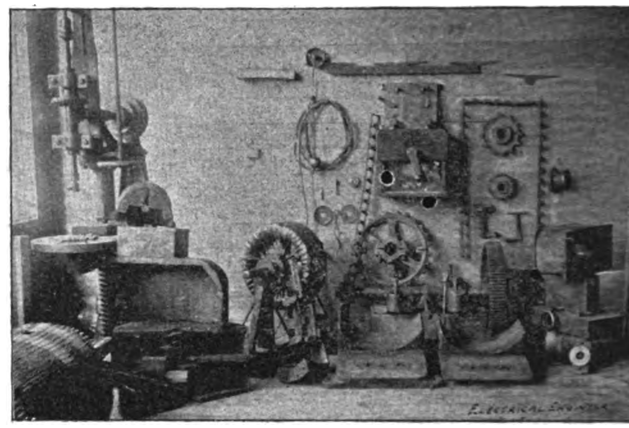


Replacing a Trolley.

a beautiful Canadian General Electric-Edison "32" generator, with the old Van Depoele as a reserve.

III.

The old-fashioned line equipment is not less interesting than the power apparatus, and the fact that it has been kept in use down to this time in spite of the awful difficulties of maintaining an overhead metallic circuit, speaks well for the pluck and skill of the pioneers. The trolley wire was drawn by the Roeblings, and must be good, honest stuff, for after six years of use it shows little loss from its original three-tenths inch diameter, and the chief noticeable wear is at the sides, on the curves. Bracket and cross-suspension methods were employed. Insulation was not merely poor



Mr. Symmes' Scrap Heap.

but primeval. Nothing but wood was used. For cross-suspension insulation, a piece of wood was turned round, grooved on one side, the wire placed in the groove, and a shutter or plug of wood to fit the groove placed on top of it. The ends were then bound with wire and the hangers were clamped around the wood.

It goes without saying that it was a hard task to get a trolley that would run on the wire and stay on. The early forms were always in a condition of uneasy and uncertain equilibrium, and when they came off and hit the top of the car with a clap of thunder, the passengers were ready to begin suit with the help of a wily lawyer, for heavy damages from electric shock. I believe one or two such suits were actually begun at Jamaica, L. I. The trolley shown at the beginning of this article was an "improvement" on the Van Depoele original and was invented by a local genius. It works well, as I can testify, but still has a groggy inclination to tumble over, and as it weighs 10 pounds, it can be readily imagined that a blow from it is serious. It is now installed in my office as a curiosity, and I notice that the charwoman rarely moves it. The weight is obviously a great drawback, and we all know how lively was the sense of relief and gain when the reign of the underrunning trolley began.

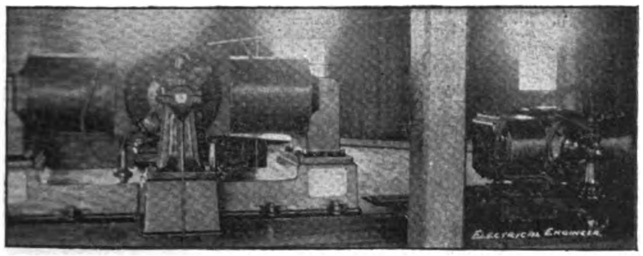
The wires to the trolley hang loosely, and the trolley trails along a few feet behind the car to which it is delivering current. Whenever the weary, wobbling device falls off, the conductor restores it to the line by means of an implement like a refined hay fork, which might also be utilized as an effectual weapon in those mythical districts where people are said to oppose the introduction of electricity. From the peculiar nature of the double overhead construction, and its effect on switches and turn outs, these forks are very frequently needed to handle the trolley.

I understand, however, from Mr. Symmes, that the change from the old order to the new, is about to begin, and that in adopting the underrunning trolley with the single overhead circuit, he will use the discarded side as part of his earth return. Much of the detail apparatus must, however, be thrown away, and my respectful advice to the museum authorities in Canada is that they secure Mr. Symmes' scrap heap before the last traces of this early electric railway work in the Dominion are lost forever. I have no doubt Mr. Symmes will treat them as generously

as he did me, when he allowed me to walk off with the trolley from a car on duty.

IV.

I have intimated that the road has entered upon a new lease of life, and it was gratifying to note that it has not



VAN DEPOELE GENERATOR AND EXCITER.

only increased its power plant and rolling stock, but has built a very handsome new car barn and offices, of the most modern design, with a classic front and all possible conveniences for officers and men. In the machine shop, an old rewound Van Depoele motor drives the lathe and drill press, as well as the blower in the smithy. Three tracks run into the building, connected to the main line by three parallel curves, and under the tracks nearest the machine shop are two large pits lined with brick laid in hydraulic cement. The woodwork of the car barn is a pretty combination of cedar, chesnut and pine.

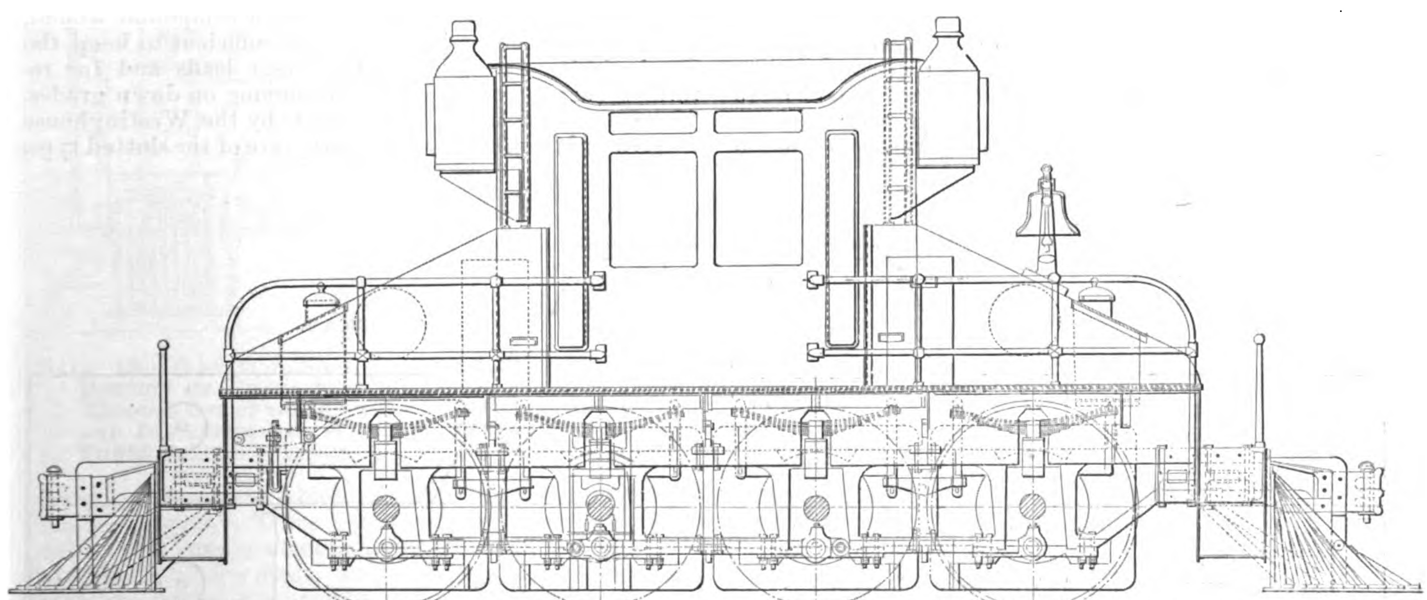
I should add that the barn is electrically lighted from a home-made storage battery, and will probably be heated electrically, as are the cars. The company has already 600 h. p. of water at command, and does not pay a king's ransom for it. The road is, I should say, the cheapest to run in all America, except where culm is available at about 25 cents a ton. In view of having so much cheap power, the company is installing a 1,000-lamp lighting plant this fall. Negotiations are also going on with the Dominion Government for the purpose of securing the right of way over the Welland Canal bridges, and when this is secured, four miles will be added to the existing five or six, and eight more cars will be put in operation.

In justice to the vanishing system, it should be stated, in conclusion, that the view in which the motor, a team of horses, several men and numerons small boys are busy trying to get the car through the snow, was taken on the only day last winter when the road was blocked. It is pleasant to say a good word for an old friend at parting, and well to remember that but for the overrunning trolley, the underrunning might never have been.

THE 1,000 H. P. SPRAGUE ELECTRIC LOCOMOTIVE.

THIS locomotive was designed by Messrs. Sprague, Duncan & Hutchinson, Ltd., and is being built under their supervision on the order of the North American Company. It is intended for special experimental work in handling heavy freight trains and switching, and hence is built for slow speeds and heavy traction. The machine is not yet entirely finished, but is sufficiently advanced to permit a fair description of it. It has been built piecemeal, the running gear and cab, much of the furnishing and the assembling being done at the Baldwin Locomotive Works, Philadelphia.

The general features of the locomotive are shown in the accompanying plans and elevations. There are points of similarity in the construction to what is known as the "Consolidated" type of locomotive used for heavy freight and yard work. The framing has a heavy steel forging with exceptionally deep pedestals, and is arranged to receive four pairs of boxes fitted with the usual slide key adjustments. This frame and the superstructure are symmetrical, and the former is provided with freight buffers and iron pilots. The pedestal boxes are of a special form, are made of cast steel, and project inward to form the brackets which carry the motors. The lower sides are arranged to be



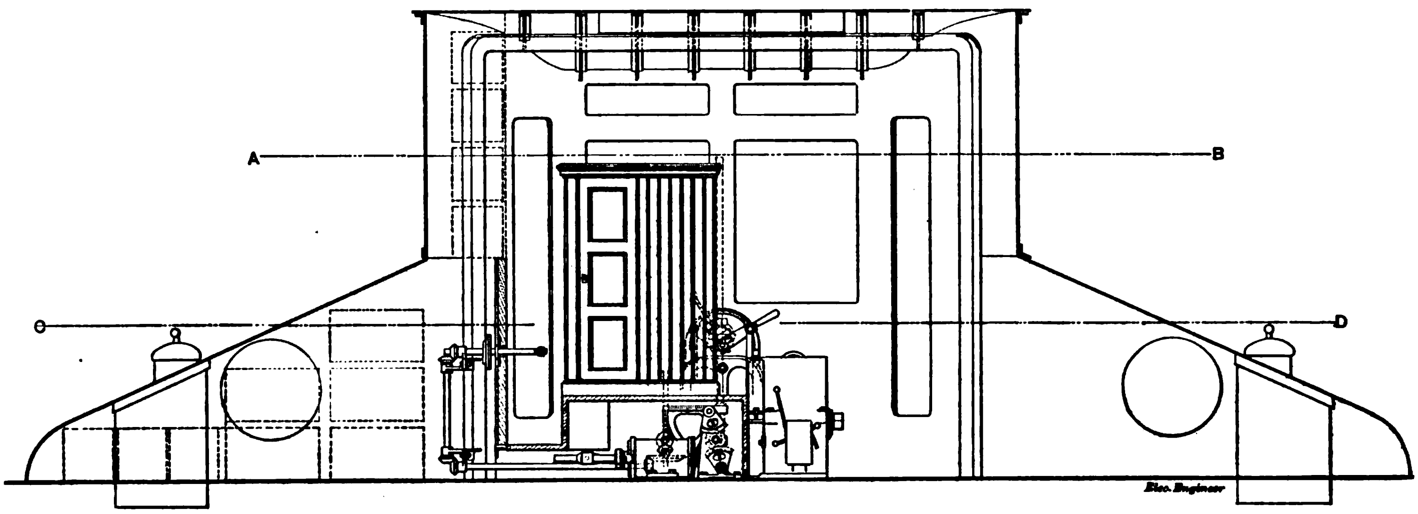
1,000 H. P. SPRAGUE ELECTRIC LOCOMOTIVE.—SIDE ELEVATION, SHOWING CAB, FRAME, PEDESTALS, DRIVERS, CONNECTING RODS, EQUALIZING SPRINGS, ETC.

dropped out so that the brasses can be readily replaced in the usual manner. These boxes are very massive and perform the double service of carrying the axles upon which the armatures are rigidly mounted and the field magnets concentric to them. A stirrup projects from the upper portion of each to engage the middle section of inverted eliptic springs, the four sets of which are arranged on the double three point suspension system common in locomotives having four pairs of drivers. In this way the whole superstructure is carried on equalizing springs, and each pair of drivers is allowed to conform to inequalities of track without disturbing the joint distribution of load. The drivers are 56 inches in diameter, the end ones only being

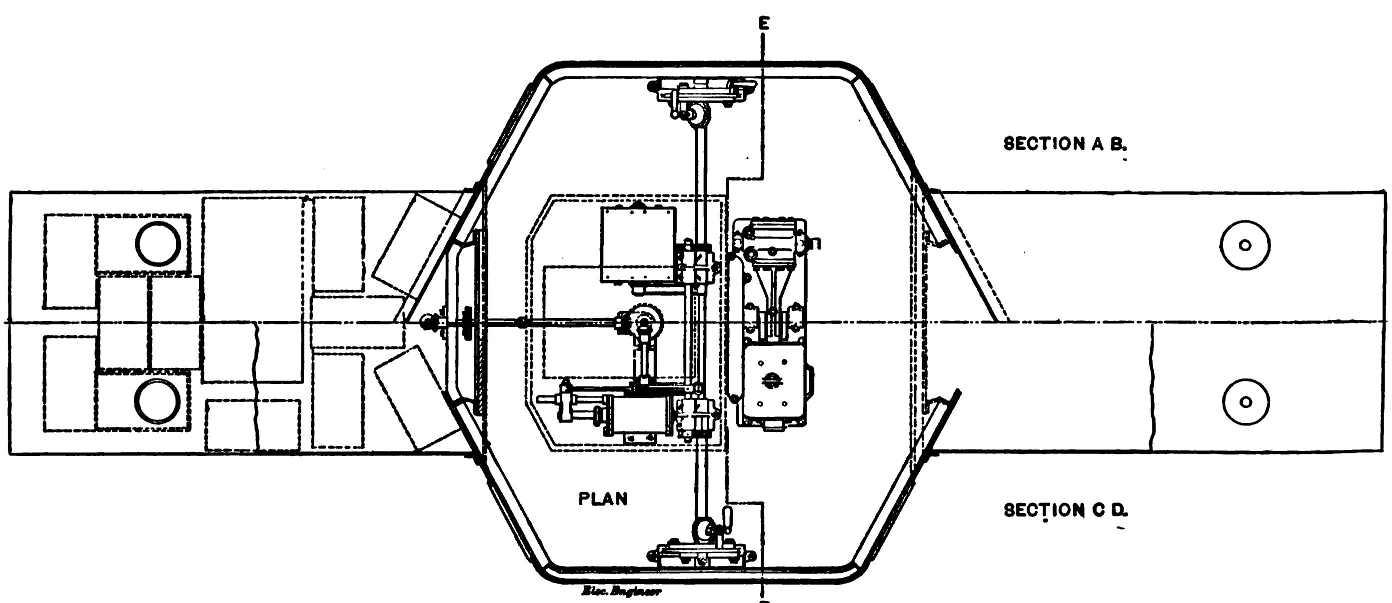
flanged. They are close coupled, with only four inches between the faces, and the connecting rods are double jointed to allow flexibility of movement.

It will be noted, that the weight of the armature is directly on the wheels, and not on the journals, while that of the field magnets is on the journals through the pedestal boxes. There is then absolutely no spring support of any kind provided for any part of the motors. This is contrary to the prevalent opinion of what is necessary in a machine of this type. Another difference distinguishing this locomotive from the large one designed for the Baltimore & Ohio Railroad tunnel is that this system is a unit, the motors all forming part of a single system having a rigid wheel base of 15 feet, and being coupled together by quarter-cranked connecting rods instead of having two or more bogie trucks with independent spring supported motors.

Among the considerations determining this construction were, the simplicity and directness of application, the impossibility of operating two or more motors in series satisfactorily on a slippery track when the full tractive effort is required of them without a mechanical coupling, and the likelihood that with large drivers, each flexibly connected to the system, the troubles anticipated from rail impact would not be as serious as has been commonly supposed. This apparently coincides with an expression of opinion by the Messrs. Hopkinson in an article recently published by them describing the operation of the underground railroad in London, in which they say in effect, that it is a mooted point whether there is any increased track deterioration due to direct mounting. The motors, four in number and alternating in position, are of the "Continental" ironclad type, the field magnets being formed of two steel castings, and having two field coils placed at the ends of the motors with their planes vertical, thus forming two consequent and two salient poles. The magnets are compound wound, the shunt field being light and only sufficient to keep the speed within reasonable limits at light loads and for returning current to the line when running on down grades. The armatures, which were built by the Westinghouse Electric & Manufacturing Company, are of the slotted type, the slots having curved bottoms and tops and contracted gaps. Each slot carries four wires, but there is only one turn of wire to each bar of the commutator, and the wires are threaded through tubes imbedded in the slots. The winding is of the two-path type, giving the current only two paths in the armature. Its dimensions are :



SIDE ELEVATION OF CAB, SHOWING CONTROLLING APPARATUS, COMBINATION CYLINDER AND PUMP.

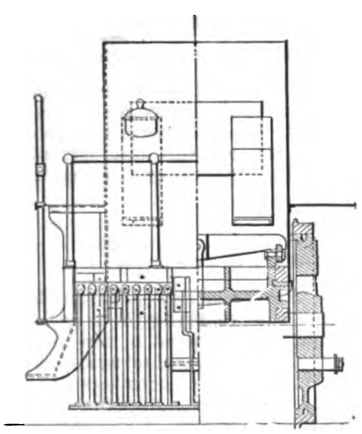


PLAN OF CAB, SHOWING THE CONTROLLING APPARATUS, AIR CYLINDERS AND ELECTRIC PUMP.

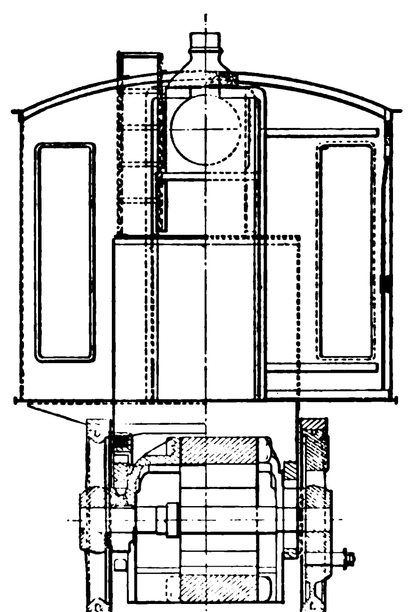
Diameter	31	inches.
Length of active part	21	"
Number of armature coils	237	

The height of the steel casting over all is 46 inches, and the clearance from the top of the rail, 5 inches. The induction in the teeth of the armature is very high, being about 22,000 C. G. S. lines.

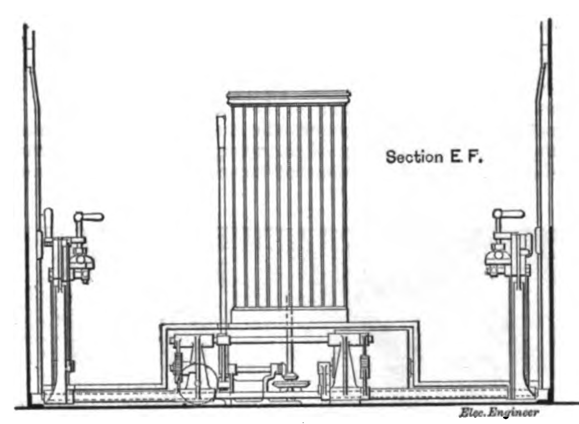
The motors are wound for 800 volts at 225 revolutions, this being the equivalent of 35 miles an hour when in multiple. They will safely carry 250 amperes of current, giving each motor about 250 h. p. output at 93 per cent. efficiency, and in emergencies can easily stand a great deal more than this. The motors will readily exert a draw bar pull of over 30,000 pounds, and have a system of regulation giving any speed from zero to 35 miles an hour under full normal tractive effort. They can of course start very heavy loads and have ample capacity to slip the wheels. The regulation is of the series parallel system with resistance thrown into, then cut out of circuit, then again into circuit while changing. The groups are, first, all in series with and without variable resistance, then two in parallel by two in series, then four in parallel, with similar use of rheostat. The four motors are used all the time, there



Half End Elevation, Showing Portion of Pilot, Section Through One of the Drivers and Equalizing Bar of the Three Point Suspension.



End Elevation and Section Showing Cab, Pair of Drivers and Axle, Section Through Frame, Pedestal Boxes and Field Magnet Castings.



Cross Section of Cab Showing Part of Controlling Apparatus and Combination Cylinders.

being no position in which one alone is cut out, not even in changing over. These various changes are effected by means of a large contact cylinder on which the three main combinations are made, and a fireproof rheostat system with the contact arm geared in the proper ratio to the main cylinder.

To effect the prompt operation of this controlling system, which can be moved slowly by hand, air pressure from the same tanks that supply the air brakes is employed. This is automatically kept at a constant pressure by a special electric pump. It was deemed essential that it should be unnecessary for the engine man to watch indicators or gauges of any kind in order to know on what switch position he was running, and to this end the air valve which he controls is mounted on a small lever so geared as to move back and forth as the main cylinder revolves. His hand is thus carried along so that he knows intuitively the position of the cylinder, and has no reason, ordinarily, to use his eyes and ears for purposes inside the cab. There is a reversing switch which is automatically locked in all but the "off" position on the main cylinder, thus preventing reversal under wrong conditions. There are ammeters, voltmeters, a whistle, bell, headlights, and the usual accessories. The system of brakes is that known as the "American," and is applied to every wheel. The controlling apparatus is all carried in the cab, which is centrally mounted, has wedge-shaped ends and forward inclined sections running down to each end of the locomotive. The cab is heavily framed so as to carry two trolleys. The ends are narrowed and hand rails flank it on either side.

The cab is provided with seats on either side and the controlling apparatus is so arranged that the engineman sits at the right side looking forward, no matter which way he is normally running, and has similar hand movement. Steps give access to the pilot platforms at either end, and ladders to the top of the cab. The total weight of the locomotive will be about 120,000 lbs. equally distributed on the drivers, and it is by far the largest yet built.

ELECTRICITY ON THE NEW YORK AND BROOKLYN BRIDGE.

There is talk of the use of electricity for propelling the Bridge cars. It is said that Superintendent Martin, when in Chicago recently, gave special attention to the operation of the Intramural railroad, with a view to determining the practicability of using the same system on the Bridge. He may have something to say at the next meeting of the trustees on this subject. Why would this not be a good chance for a "moving sidewalk" like that in operation on the long steamboat pier at the World's Fair?

ELECTRIC MAIL SERVICE.

The Amesbury, Mass., *Daily* suggests that now that the electric car service is so much better, between Merrimac Valley towns and cities, than the steam car service, there is no reason why the former should not be given the contract to carry the mails. The mail service at present between Amesbury, Merrimac and Haverhill is very unsatisfactory. The old-fashioned stage route is still in existence which gives only one direct mail each way daily. If the Haverhill and Amesbury Railroad Company were given the contract, there would be three or four mails each way daily, the expense not being very much larger than it is at present. With the new trade relations which have been opened between these places since the road was opened, the mail business has increased and better facilities are required.

A TEST OF THE "UNIVERSAL" CONDUIT ROAD AT CONEY ISLAND.

In The Electrical Engineer of July 5, we illustrated and described the interesting conduit road installed experimentally at Coney Island by the Universal Electric Railway Company, of New York city. In this system, as will perhaps be remembered, the conductors are laid in a comparatively shallow and simple conduit, and the current is led into the motor on the car by means of successive points of contact, the device disconnecting automatically after the passage of the car, and becoming temporarily "dead" until the next car comes along. The devices swing on a pivot in the direction of the car's travel, and engage in sliding contact with a long shoe placed under the car. The switch boxes are hermetically sealed and leakage appears to be practically impossible. Full details will be found in our article, and Fig. 1 gives an excellent idea of the circuits and of the principle upon which the conduit operates.

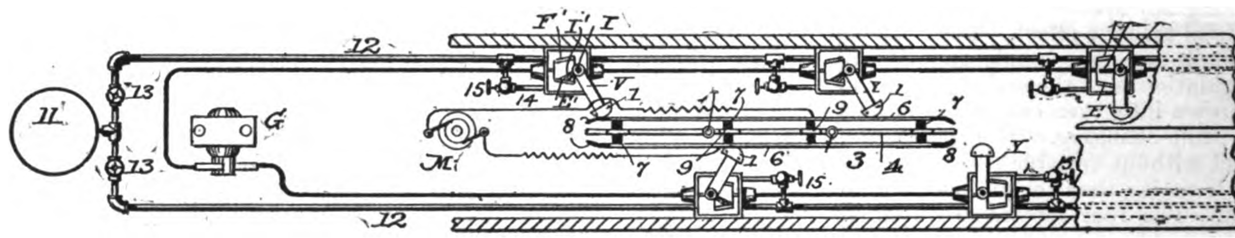


Fig. 1.—The Universal Railway Conduit System.

Several tests have been made from time to time this summer, and noted in the electrical journals, as to the practicability of the system, and more particularly as to the feasibility of its operation in heavy rains, snows, and thaws, when the conduit might fill up —as conduits most assuredly will. None of these tests, however, were of a thoroughly definite character, and upon the suggestion of the Engineer, Mr. Albert Stetson, general manager of the Universal Company, at once consented to such a specific test. Preparatory to the ordeal, on Sept. 20, a stretch of the conduit was filled up with water so that the switch contact boxes were most effectually submerged, the insulated cable connecting them, lying also at the bottom of the trough imbedded in sand and water and mud. Fig. 2 is a view of the conduit taken at the time, with the water still pouring in. The car laden with passengers and with a large portion of the juvenile population of Coney Island, went up and down the whole line easily, and on that section experienced no difficulty whatever in running at full speed, stopping, starting or reversing. The tests were made by Mr. E. W. Stevenson, well known as the electrician and subway expert of the Brush Illuminating Company, of New York, and were witnessed by Prof. Anthony, by a member of the Engineer staff, and several others. The report is here given:

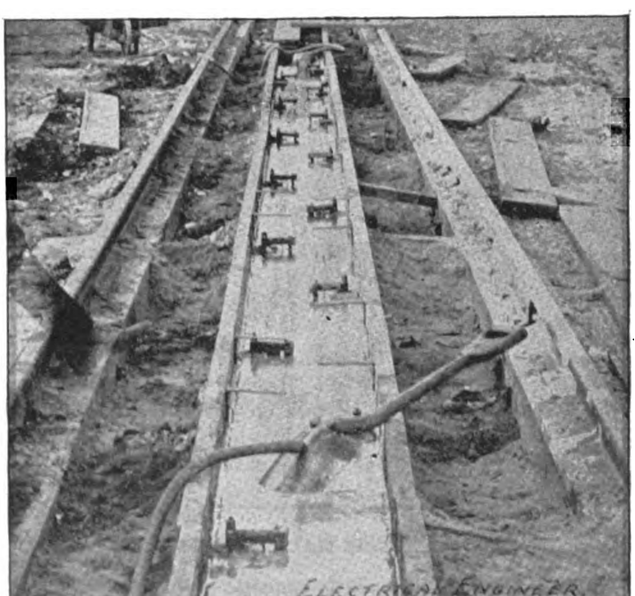


Fig. 2.—The Universal Railway Conduit.

Albert Stetson, Esq.,

No. 50 Broadway, New York City.

Dear Sir:—In accordance with your request of yesterday, *in re* the tests made by me on the new Electrical Conduit and Car at Coney Island, I beg to submit the following report:

The insulation resistance of whole line, when the car is not in circuit, equals 61,500 ohms. The insulation resistance of line, with shoe of car and adjacent switch boxes in contact with shoe submerged in water, equals 380 ohms.

E. M. F. of power circuit equals 353 volts; $\frac{353}{380}$ equals .926 ampere loss.

75 feet of conduit were pumped full of water previous to test. With Weston Ammeter, the reading was hardly discernable. The loss on boxes tested by Weston vo'tmeter showed nothing. The resistance test was made wi h Thomson tripod galvanometer and by comparison with standard res'stances.

From the above figures, the following result is arrived at:

As 75 feet of the conduit were submerged, this would include 12 boxes. Therefore, it is safe to assume that the loss was only on those boxes. Several of the the dry boxes showed no leakage.

Then, as the loss on the circuit, with boxes all open (that is electrically), was .0058 ampere, equaling .0027 h. p., the loss on each box equals $\frac{1}{12}$, which amounts to .000483 ampere, and which equals .000223 h. p. It, therefore, would take 4,464 boxes entirely submerged to give a loss of 2.118 amperes or 1 h. p., and as the boxes are six feet apart, this equals 5.092 miles.

The car standing with the shoe entirely submerged and the two adjacent boxes with switches turned on, showed a loss of .926 ampere, equaling .438 h. p., and as the car takes about 12 amperes, equals 5.68 h. p. on ordinary track, this shows that it loses 7.69 per cent. of its power when so placed; or, expressed differently, 13 cars placed in the same condition would lose about the same amount of power which it takes to drive one car.

(*Signed*) E. W. Stevenson,
Electrician,
Brush Electric Illuminating Company.

It will be seen at once that a high degree of insulation is reached. It would also appear that under extreme conditions which no railway manager would be likely to permit or be subjected to in even the worst' weather, the conduit and car stood up to their work in a most satisfactory and even remarkable manner.

AN ELECTRIC FUNERAL CAR.

About nine miles distant from San Francisco are four large cemeteries and a crematory, and it was to bring them near the city that an electric railroad company introduced a new hearse. Its first patron was a benevolent organization, one of whose members had died. At the time appointed for the mourners to leave the city the electric funeral-car, appropriately draped in black, was in readiness. The body was lifted by the pallbearers from the undertaker's wagon to the car, and the bearers took their seats in a section reserved for them. The conductor rang the bell twice, the motorman clanged his gong to clear the track of a mob of interested spectators, and the funeral procession started, the mourners in electric cars following the hearse. The run from the starting point to the cemetery was made in one hour. The car was switched off on a track inside the cemetery gates and the pallbearers lifted out the coffin. Then the funeral procession was reformed and slowly moved off towards the chapel.

THE P. R. R. AND THE TROLLEY.

It is said that the Pennsylvania Railroad Company will soon take action to prevent the Lancaster and Philadelphia Electric Railway from crossing its tracks. The electric line is to follow the old Philadelphia and Lancaster turnpike, and this crosses the Pennsylvania Railroad at two places, once near Malvern, where it crosses under the railroad from the west to the east side, and again near Coatesville, where it crosses from the east back to the west side. At the latter point the turnpike crosses over the railroad. The railroad company holds that it has right of way, or owns the turnpike at these two places, and will ask the court to enjoin the electric railway from laying its tracks either under or over the railroad.

ELECTRIC AMBULANCES.

The St. Louis city authorities have decided to build one or more electric ambulances. The various street railways have consented to supply power and free use of their tracks, and the car will be switched and run to any part of the city desired.

TROLLEY ACCIDENTS.

[It will be remembered that in The Electrical Engineer for September 27 appeared an editorial on the subject of so-called "trolley accidents" as chronicled in the columns of the daily newspapers, most, if not all, of which are found to be directly traceable to insufficient or imperfect controlling apparatus or brake mechanism. We print below several letters on the subject from men prominent in the profession and practice of electricity and railway work.—Eds. E. E.]

Your editorial in The Engineer of Sept. 27, concerning "Trolley Accidents" is timely and to the point, and it is also probably true, that something yet remains to be done to give the motorman more complete control over his car. But before we criticize the trolley too severely as an incompleted machine, it may be well to bear in mind, as you point out, that, notwithstanding all that has been written about the "deadly trolley" in the non-technical public prints, when we consider the number of people carried, the speed maintained and the crowded condition of the thoroughfares through which much of the running is done, this "deadly trolley" so-called, presents a record of service and safety that stands without a parallel in any age with any mechanism.

This wonderful showing has been made possible only by the peculiar adaptability of the force to the use; by the success of the inventor in devising ready means of control, and by the ability and faithfulness of the much abused and greatly underrated motorman. It also should be remembered, that the trolley car was designed to replace the horse car. Consequently, whatever had been found to be best in horse car practice, if it would apparently serve for the new use, has been retained. This is true of the present trolley car brake, which is simply the horse car brake made more powerful; and in fact, as powerful as possible. For, with the fixed limit of the motorman's strength, as the force, it is probably impossible to further increase the strength of the present hand brake without increasing the length of time required to operate it.

But here comes the difficulty. The weight and speed of the trolley cars as compared to that of the horse cars far exceeds the effectiveness of the trolley car hand brakes as compared to that of the horse car brake. And if they were the sole means of stopping the trolley car, the list of accidents chargeable to the running of the trolley would be much larger than it is. But, as is well known, every trolley car is provided with a quickly operative reversing mechanism by the use of which the whole power of the motor can be used in stopping the car. This reserve means of braking is being continually and successfully employed to prevent serious accidents, but, unfortunately, the use entails a sufficient likelyhood of injury to either the electrical or mechanical parts of the motor to prevent its being of the fullest service. Furthermore, having reserve means for avoiding accidents may be well enough in cases where it is likely to be seldom required. But the "reverse" is of such frequent need on trolley cars that there is always the danger that it will be either used too frequently for the good of the motor or too seldom for the safety of the public.

Now, as has been pointed out, the trolley car was designed to replace the horse car; but the present requirements of trolley car service are such that trolley practice is more akin to steam locomotive practice than to horse car usage. And it seems to me that the next step in trolley improvement should be to borrow another point from steam locomotive practice and equip every trolley car with compressed air brakes and an independent electric motor for compressing air. The expense of such an additional equipment to the present apparatus is not prohibitive when the high class of service performed by the trolley is considered. And undoubtedly the increased safety and popularity of the improvement would more than compensate for the greater cost.

Furthermore, when the motorman is provided with a reliable air brake for stopping his car in addition to the present electrical brake his duties will be less arduous and performed more to the satisfaction of his employer and the public.

David E. Lain.

Middletown, N. Y.

I read with considerable interest your editorial in the current issue of the Engineer. The number of accidents caused by inability to stop the motor cars quickly enough, forces one to the conclusion that in some cases at least the braking devices are not powerful and reliable enough. I believe, as a general rule, that the men in charge of electric roads are doing everything reasonable within their power to make travel perfectly safe. They are also on the lookout for improved methods and improved devices.

I have to suggest five lines in which improvements can be made for making the cars safer. There certainly seems to be room for improvement in the fenders or life guards. I look also for improvement in the method of reversing the cars. It seems to me to be a step backward in having two levers for the control of the cars. There have been several accidents reported recently, notably that on the Avondale line in Cincinnati, where apparently the motorman reversed his motors without cutting off the current. In so doing he seems to have burned off the connections and rendered the motors useless. The cost of altering the controlling mechanism so that the motor may be reversed and regulated by the movement of one lever is small as compared with the additional safety thereby secured. A large part of the energy overcome in stopping a car is in the inertia of the heavy armature. When some one perfects a successful method for using a shunt or compound wound motor whose armature shall run continuously in one direction and is connected with the car axle by means of reversible clutches or some equivalent device, a large part of the difficulty in stopping motor cars will be removed.

The fourth suggestion I have to make is the adoption of powerful track brakes, such as are used on some of the cable roads. The latter would be of especial value in winter when the tracks are slippery and the wheels skid easily. My fifth suggestion is that each brake be fitted with a reserve chain attached to the winding post and a little longer than the working brake chain. I believe that the motormen, as a general rule, are very careful for the safety of others and no one is more anxious to have the cars perfectly safe.

I am glad you are taking up this subject and hope that much good will come from the agitation.

Geo. D. Shephardson.

Minneapolis, October 2, 1893.

The question of "Trolley Accidents" is one, I believe, which ought to be considered from several points of view, namely:

1. Rapid transit and the public (not "the public be d——").
2. Electrical manufacturers and their apparatus.
3. Car brakes and safety appliances.
4. The motor man and street railway management.

1. On the question of rapid transit and the public, the latter is compelled to adapt itself more quickly to the changed condition of matters on the street, and to realize that it must take precautions to protect itself, and not expect the motorman to do its thinking for it. There is no doubt that the public is seemingly slow in becoming accustomed to these changes, and yet it is the one which demands and requires this rapid transit and compels its continuance, and even its increase, in spite of all accidents. As time goes on, people adapt themselves to these conditions and cross the streets with as much safety as before.

2. In regard to the apparatus furnished by the principal electrical manufacturers, that is, the present type of series-multiple controlled motors, we know it is a very efficient type of motor, and well adopted for operating and controlling the car in an economical manner, and with safety when operated in connection with proper brakes and safety appliances. The motor is far stronger and more efficient than the motor manufactured a year ago, and the fact seems to be overlooked that the motor should not be held fully responsible for stopping the car.

3. The question of car brakes and safety appliances is, to my mind, one which has been largely overlooked. Better and more powerful brakes than are used in many cases are a necessity, and must be kept well adjusted. There is also no doubt but that air brakes are a practical success at present for street car work, and are going to be demanded when roads operate at high speed. They add greatly to the safety of rapid transit. The more frequent use of the retarding force of the motors on reverse speed, with a good sand box and dry sand, should be thoroughly impressed upon the motorman by inspectors and superintendents. Many accidents have been prevented thereby to the writer's knowledge, but some officials seem to prefer risk to human life than to the motor.

Last, and more important than any of the foregoing, is the equipment of every car with a guard which will not mangle a person, as is done by the ordinary timber with which most of the trucks are equipped, but a guard consisting of a scoop netting in front of the car, which under no circumstances allows a person to pass under and be crushed by wheels, etc., but catches and holds, and, at most, only causes a slight injury from bumpers and coupling rods. Guards of this description are used in Cleveland, Buffalo, Boston and other cities, and I fail to see, for my part, why any company hesitates one moment about their adoption, when the cost of one life will more than pay for equipping any ordinary road. They are manufactured at small cost, in a number of forms, most of which are not patented.

4. As to the question of the motorman and the railway management's responsibility for accidents, I would say that I do not charge the motorman with a lack of brains. I believe the average one is an intelligent, capable operator. What I do say is, that they should be instructed by practical experience under able instructors, and with dummies, etc., to represent persons, in the quick stopping of their cars under every conceivable circumstance, for I know that many accidents are due mainly to the motorman not using all the forces under his control to prevent them.

I fully believe that a tramway operated as above indicated under competent management, will prove that the electric tramway is the safest, most flexible and best adapted to city traffic of any of the various methods of rapid transit, and we have only to look around at its triumphal march of progress and conquest into every city of the land to see the proof thereof.

C. J. Field.

New York, Oct. 9, 1893.

THERE is one point in the editorial in THE ELECTRICAL ENGINEER of Sept. 27, on the matter of car brakes, which is scarcely as it should be. The blame of inefficiency in controlling mechanism is entirely put on the shoulders of the companies who turn out the car motors. In view of the fact that in only exceptional cases do the electrical manufacturing companies supply the complete car, this blame should more correctly be put on the truck or car builders. Certainly in this country, and I think in a great majority of cases in the United States, the motors and electrical equipment alone are ordered from the electrical companies, and when these companies do turn out the complete car it is usually of a special build and fully equipped with some mechanical braking device. The problem, however, is a serious one, and if the street railway managers can be brought to look upon it in this light and to demand a better system of braking, there is little fear that it will be forthcoming. The principal trouble is in the small space allowable for any mechanism other than that propelling the car, and further, the dirt and wear and tear which the mechanism would be exposed to underneath the car.

I have thought that it would be a comparatively simple matter to arrange a positive brake by converting the motors into generators delivering into a dead resistance. Take for example the Thomson-Houston standard rheostat equipment. If, when the car is running without current, the reversing switch is thrown over, the car is almost immediately brought to a dead stop. This is caused by the motors acting as generators, and the sudden jerk is simply the result of their being dead short circuited. If they can be arranged to deliver into a comparatively small resistance the stop would be more gradual and the sudden strain on the motors and gears would be done away with. Some device of this kind would very soon be forthcoming if an energetic demand for it was made by the street railway people.

In the meantime there is one small change in the present hand brake which I have found to add greatly to the facility with which the car can be controlled, that is, by replacing the present ratchet lever with an ordinary hand wheel. The ratchet lever is good enough on horse cars which are light and require comparatively little force to stop them, but with a heavy electric car it is simply impossible for a man to swing this lever around with one hand, and the resort is taken to working it in short strokes of the ratchet, by which method there is an addition of 50 per cent. in the time required to put the necessary pressure on the brakes.

I have found from practical experience that in a very short time the motorman becomes very expert in the use of the hand wheel and can stop his car in shorter time and with less exertion than in the old way.

W. T. WETHERFORD.

TORONTO, Can., Oct. 3, 1893.

THE editorial in THE ELECTRICAL ENGINEER of Sept. 27, in reference to trolley accidents, is well timed, and while the motorman or "motorneer," as he is sometimes called, is not altogether the party to blame in reference to the accidents whice are now being, and have been, reported very largely in the papers in this vicinity, it is nevertheless true that some method is required in the operation of electric cars, whereby a car can be brought to a stop without injury to the motors and independent of the brakes wherever it is necessary to prevent the loss of life, or for any other exceptional interference with the traffic.

I am pleased to say that in a short time I will be able to bring forward a system which will cover the following points:

1. A single motor supported flexibly on truck without increasing the dead weight on the axles. 2. Motor to be constant speed and to run whether car is stopped or in operation. 3. An exceptionally simple device for conveying power to both car axles; this device is arranged so that the speed of the car can be varied to suit the requirements while the motor is running at constant speed. This is accomplished, also, without any loss of power, caused by friction, etc., which would naturally prohibit the use of such mechanism. 4. A simple and cheap method, which is also positive and effective, for reversing a car without reversing the motor. 5. This reversing device operates in such a manner that when it is adjusted to permit the car to run forward, it is utterly impossible to run the car backwards until the reversing mechanism has been operated to permit this movement of the car. 6. With the constant speed motor, there is no need of any controlling mechanism similar to the multiple series controller. 7. The car is operated by one lever which starts and stops, reverses, and changes the speed of the car as desired. 8. If desired, the constant speed motor could be of the synchronous type.

With a car equipped in the above manner, should it be necessary to reverse the car to save a human life, it would not be necessary to use the brake at all, in order to bring the car to a stop, as the reversing mechanism absolutely locks the wheels so that they cannot revolve in the same direction in which the car is going, and the car must therefore necessarily act as though the wheels were skidded, and would slide along the rails while at the same time the motor would be running, but with no load on it. Or, if desired, the power could be utilized to turn the wheels backwards, as is usually done now with the common method of reversing; but such would not be necessary, as the means for locking the wheels without injury to the motor would be undoubtedly all that would be necessary to use in such a case.

Another point of great advantage, is that it would be almost next to impossible to have an accident similar to the serious one which occurred recently in Cincinnati, where the car went down a grade, the brakes or the motor failing to operate. Also in going up a grade, it would not be necessary to have the car stop with the brakes on, as the mechanism conveying the power from the motor to the axles operates only in one direction unless the same is reversed, and when the car is going in either direction, it is impossible to run it backwards, unless the reversing mechanism is thrown into action.

F.

NEW YORK, Sept. 29, 1893.

THE editorial on the above subject in THE ELECTRICAL ENGINEER of September 27 has been called to my attention. Everyone must agree upon the apparently unnecessary number of fatal accidents, and many of us will agree with the editorial as to the part of the apparatus which is often to blame.

Of course there are accidents that are cried on the streets as the result of the "deadly trolley," which have no connection with it, but we all know that there are too many accidents rightly attributable to electrically propelled cars.

Within the past few months I have made extended visits in four cities using electric motors of all the principal makes. The first city was an eastern one and had an average of one fatal accident every week for five weeks. In that city there were three or four hundred electric cars in operation. The accidents—fatal and otherwise—that were not due to utter carelessness seemed attributable to two causes—the racing of cars down grade, and inability to operate the controlling switch quickly. Not only were three distinct operations necessary, involving two separate handles, but the reversing switch operated very hard and, as an actual fact, had to be pulled in different directions on different cars, in order to reverse.

Consider the case of one of the Western cities, where there are two different electric systems, one of about 30 cars and one of about 55 cars. On the first, whose cars have controlling switches operated by two handles, accidents have been so numerous that standing orders have been issued to the motormen, prohibiting the use of the highest two speed points on the switch. The schedule time is thus reduced to nine miles per hour. In the case of the second road, which uses a switch having one handle, the schedule time is ten miles per hour. The manager of this road stated a short time ago that they were troubled over the number of accidents caused by their *horse cars*, which in the past year have been the cause of more accidents than the electric cars. The company has about a hundred and fifty horse cars in operation.

Without further examples, let us examine the cases of the two cities mentioned above. The first cause of accident (that from dangerously fast running on down grades) should be easily eliminated. Fast motors are often objected to as being dangerous, yet any motor can run too fast down hill. Given a motorman behind his schedule time with a loaded car and the knowledge that all lost time means overtime without additional compensation; place this combination at the top of a hill and the probable result will be a speed of twenty miles per hour on the way down.

The cure for this is to have the motors sufficiently powerful to pull the maximum possible load up the heaviest grade under consideration at such a speed as will not necessitate rushing over the rest of the run to make up lost time. Then the motorman can be held to his schedule without danger to the rest of the occupants of the street, A motor can stand a heavy overload for a short time. Let it be able to make good speed up grade. People are not run over by motors running fast up hill.

There is beginning to be a call for city ordinances limiting the possible speed of the motor. The way in which this is apt to be met (taking into consideration the features of series motors) is simply by using less powerful machines. Then when heavy loads are encountered, the schedule time is lost and both the passengers and the street railway company are inconvenienced. Restricted speed may be right, but restricted power is all wrong. Let the speed be restricted when necessary, but keep good strong motors, so that when heavy loads are hauled or the voltage is low the speed on the level and up grade will be such as not to necessitate coasting down hill in order to catch up. Fast horses are not prohibited because they might be dangerous if run at their maximum speed in crowded streets. Why is it not as easy for the speed of street cars, which have large numbers painted on them, to be properly governed by rules?

Next, as to the controlling switch in its connection with the motor. I have heard the suggestion to reverse as a test of a motor met with exclamations of surprise at such wanton abuse. If this is the state of mind when it comes to avoiding an accident, the caution is apt to rise too strongly in the motorman's mind "reverse as only a last resort"—and in a few seconds it is too late for a last resort. The motor sho

(and there are motors that are) capable of reversal without damage, and the motorman, while instructed not to reverse for ordinary stopping, should feel perfect confidence that he can use this most powerful brake when necessary, without risking his position.

As regards the controlling switch proper; its operation should be as simple and easy as possible—while at the same time reliable and positive in its action. This calls for one handle, or, if two handles are essential, then they should be easily and simply operated, and conveniently placed.

In conclusion, I do not think that the blame lies entirely at the door of the manufacturer. In the early days of electric lighting when there were a number of fires owing to the use of faulty material and methods of construction, the cry was not raised against manufacturers; the underwriters simply formulated rules that such and such things only would be accepted, and the manufacturers promptly met the demand. When the Navy Department wanted a higher class of marine electric machinery and appliances, they made their specifications and required them to be lived up to. Every one knows the remarkable results.

Cannot the street railway companies set the standard of what they want? It is an easy matter to specify such points as the following:

1. The car, weighing so many pounds, shall be able to stop at every so many hundred feet, to take on or let off passengers, and make a schedule time of (blank) miles per hour, consuming not more than (blank) electrical horse-power.

2. The car loaded shall be able to ascend the maximum grade at (blank) miles per hour.

3. When going at a speed of 15 miles per hour on level, dry, track, it shall be possible, using all means for stopping headway, to throw off current and stop the car dead in (blank) feet, and this without damage to any part of the equipment.

Let the street railway companies, who know their own needs better than any one else can, specify what they want and then require the manufacturers to meet their specifications.

GILBERT WILKES.

WE have all heard of the boy who defined salt as "the stuff that makes 'taters' taste bad when you don't put any on," and of the other boy who made the assertion that "pins have saved the lives of a great many people by not swallowing them." It is this class of boys, who, when they arrive at manhood's estate, are hired by the daily press to write editorials on the "deadly trolley." The absurdity of these editorials is only exceeded by that of the "deadly trolley" news items.

I was once asked by a reporter from one of the great dailies, to tell him everything I could that would be injurious to the cause of the trolley. He did not ask for all the facts in the case so as to form an unbiased opinion, but candidly confessed that his journal wished to injure the "trolley" in every way possible. I am happy to say however that this was several years ago.

Public opinion has been slowly but surely coming over to the side of the trolley, in spite of the frantic efforts of the daily press to the contrary. The press itself is at last beginning to weaken, and in some cases has already been converted. A notable instance is the New York *Tribune*.

When the daily press through ignorance or obstinacy fails to keep up to the times, and lead public opinion to an inevitable conclusion, it must later on fall into the ranks and follow public opinion or be relegated to "innocuous desuetude." The historic objection urged against George Stevenson's locomotive, concerning the probable fate of a cow which might get on the track in front of it, is very absurd to us in these days, yet it is no more intrinsically absurd than the majority of objections to the trolley.

I agree with your editorial of Sept. 27th, especially in regard to braking mechanism.

One of the most serious accidents which has *really* happened on a trolley road in the past few months, was caused by a car running away down grade.

Had this car been equipped with any one of several modern devices, the accident would probably not have happened.

TOWNSEND WOLCOTT.

NEW YORK, Oct. 2, 1893.

I DO not think the present brake mechanism sufficient to properly stop the car. I do not think that the fuses should be so small, that when a motor is necessarily reversed it will burn out. I think all cars should be equipped with proper life guards. I therefore beg to offer the following suggestions as covering improvements which should be introduced and can be introduced by railway companies.

All cars should be equipped with two independent means of operating the brakes. 1. The ordinary hand brakes now used. 2. Air brakes. An air brake mechanism should be devised having either an air pressure cylinder large enough to operate a car for say four hours, or a pump should be made to attach and operate from the axle, the valves and working parts of which will not be cut to pieces in a few weeks by the dust under the car.

Fuses that will burn out under a reversal of the motors should not be used.

Life guards should be attached to both ends of the car. To make these effective a rule should be made and enforced, "That all cars measuring more than 18 foot long in the body be mounted on double trucks." When cars more than 18 foot long are carried on single trucks the "see-sawing" motion of the car is such as to render almost any form of life guard that can be devised ineffectual. The lower frame of the life guard should be fastened to the car axles in such a way that it will always remain about 2 inches above the rails whether the car oscillates up and down or not. This frame should extend out beyond the end of the platform. It should be plow-shaped, and should carry a flexible apron of canvas or rubber attached to the front of the car. With such a life guard as this it would be almost impossible for anything to get under the car.

These precautions observed, I think nothing further can be done to give the motorman absolute control of his car.

I have said nothing about the rate of speed a car should be run, but I think that a car equipped as above suggested could be run as safely at 10 miles an hour in a crowded city as the present cars can be run at six miles per hour; which latter, from a rapid transit point of view, is little better than horse cars.

S.

IT is with pleasure, I read your stirring and timely editorial on trolley accidents. Truly the way of the motorman is hard. Your remarks as to brakes are peculiarly happy and I heartily agree with you as to the total inefficiency of the present brake, which is more or less the old horse car brake strengthened and improved. A moving car has a certain momentum or *vis viva* which is impossible to overcome in a length, or at times in two lengths, by means of a wheel brake, for if the brake is put down too suddenly the wheels are gripped and the car shoots forward under a sliding motion; in my opinion a good track brake would help most cars and would certainly reduce the tendency to slide and flatten the wheels. My own experience with track brakes on grades was not very gratifying, but since that time, one year ago, the track brakes have been enormously improved. I witnessed in Washington recently a quick stoppage of two heavily loaded cable cars, on which the wheel brake seemed to have little effect, although the gripman put his whole weight to it; quickly transferring his efforts to the track brake the car was brought to a standstill in time to prevent a serious accident. I do not advocate, as does your sprightly contemporary, the *Morning Advertiser*, the pulling down of the trolley from the wire to prevent accidents; on the contrary, I am strongly in favor of reversing, and I venture to assert that any clear-headed motorman can prevent accidents if only a chance is given him; but if children, old men, and young women throw themselves under the wheels of the electric cars, no brakes, no trolley nor no motorman can save them.

H. K. McCAY.

BALTIMORE, Oct. 3, 1893.

I HAVE given the question of car braking considerable attention, not so much from any very noticeable failure of the present forms of brakes now in use to comply with conditions imposed upon them, but more by reason of attention having been called to hypothetical cases, where better forms would be desirable, or in points wherein the present methods were not thought to be sufficiently perfected. After every investigation as to possible changes and quasi improvements, I would always return to our old reliable braking system with the thought that it could not be improved upon, except in one way, to comply with one condition, to-wit:—When a car is under headway and on a slippery rail, the wheels locked, due to the brakes being set, the car sliding, with no means of checking motion except by a liberal use of sand, not always available, or by means of some outside mechanical, electrical or magnetic positive connection between car and rail. This latter scheme is the thought I would suggest. How to arrive at such a result, I am not prepared to say, but it seems to me that car braking will not be perfect until some method embodying the above point is perfected and applied.

W. E. HARRINGTON.

IT is a lamentable fact that all methods for braking electric cars, that have come into any considerable use, are quite inadequate for very sudden emergencies. The application of the brakes requires too much time, and aside from this, the wheels have such small surface in contact with the rail that wheel brakes are badly restricted in their usefulness for quick work.

If a track brake can be designed that will not foul with guard rails, switches, etc., that is reliable and easily kept in order, and that can be very quickly and powerfully applied, it will do much to diminish present dangers.

C. E. GIFFORD.

BUFFALO, Oct. 5, 1893.

MR. W. B. ROBERTS, formerly general manager of the Rockford Electrical Manufacturing Co., of Rockford, Ill., has recently severed his connection with that company to accept the position of general agent for the Muncie Electrical Works, of Muncie, Ind.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XVI. NEW YORK, OCTOBER 18, 1893. No. 285.

A ONE THOUSAND HORSE POWER LOCOMOTIVE.

On another page of this issue will be found a description of a 1,000 h. p. electric locomotive, which is nearing completion and which represents the most ambitious piece of work thus far attempted in this direction. This locomotive is the outcome of the resolve made some two years ago by Mr. Henry Villard, then president of the North American Company, after consultation with Mr. F. J. Sprague, to ascertain to what extent electricity could be applied to the railways under his direction. A board of engineers appointed by him to investigate this subject, after much painstaking inquiry drew up a set of specifications embodying their recommendations, but these have been radically departed from in the locomotive described in this issue. In order, however, to prevent any false impression from gaining ground, it should be borne in mind that this locomotive was constructed with a specific object in view, namely, to test the feasibility of handling freight at the terminal yards of the Chicago & Northern Pacific and Chicago Northwestern system at Chicago. The problem included the design of an electric locomotive of ample power which could be controlled as readily and be as reliable as a steam locomotive. Secondly, it involved a set of conductors and method of supporting them which could be relied upon for ample supply of current and continuous contact at all speeds on curves, switches and cross-overs, and finally an automatic block signaling system which would not be thrown out of operation by the use of the tracks as conductors.

Of the seven or eight designs prepared, the one adopted and described in this issue was selected, and it will at once strike the reader that it sticks closely to the best established steam locomotive practice—a rigid frame and a multiplicity of drivers connected together; and to these are added armatures mounted directly on the axles, and field magnets rigidly carried on pedestal boxes, the equalizing spring movement only affecting the superstructure. This construction is in marked contrast to the methods more recently advocated, of suspending the armatures on sleeves concentric with the axles, but the reasons which have led the designers to the form adopted would appear to be thoroughly well based on past experience.

With this locomotive nearing completion we think it well, nevertheless, to point out that its successful operation in the work for which it is intended does not necessarily mean that the problem of high-speed trunk line electric railroading would be solved. Although it will influence the solution of this problem and in some respects clear away much doubt which still exists on some points, a successful high-speed electric railway as a whole involves other conditions which do not exist in a short stretch of freight terminals. Thus, the nature of the conductors, whether overhead or on the surface of the ground, the contact devices, the best potential, the distance apart of the power stations, the best signaling devices, and numerous other important points still require work for their solution. The public will look forward with special interest to trials of so important an advance in electrical engineering.

HAIL TO CORNELL.

THE quadri-centennial anniversary of the founding of Cornell University, which has just been fittingly celebrated, serves to call attention once more to the fruitful results and great possibilities which accrue from the work of an institution of learning conducted on sound principles. The electrical profession especially will felicitate Cornell on the completion of its quarter century, for Cornell was among the first, if not the very first, university to mark out a distinct course of instruction intended to educate young men in the profession of electrical engineering, and thus set an example followed by other educational institutions. It is some ten years ago that Prof. Wm. A. Anthony, then professor of physics at Cornell, began this work, which has been successfully carried on after him by Profs. Nichols, Ryan, Moler and others, with the result that Cornell men are now occupying some of the highest positions, not only in the field of active practice, but also among the electrical educators of the country. We wish Cornell continued prosperity.

THE STREET RAILWAY CONVENTION.

THIS week will bring together at Milwaukee representative street railway operators from every section of the country, and the time, indeed, which has elapsed since their last gathering has been none too brief. Much has been accomplished in the electric railway field during the past year and the papers and reports announced for the meeting show how keen is the interest taken by the members in many subjects of vital importance. It is more than probable that the subject of "Trolley Accidents," which is now being discussed in its various phases in our columns, will claim a share of the members' attention, and the time of the meeting could be spent in no more profitable manner than in an exchange of experience and discussion of a remedy for what has come to be a menace to the very existence of electric rapid transit.

WORLD'S FAIR DEPARTMENT.

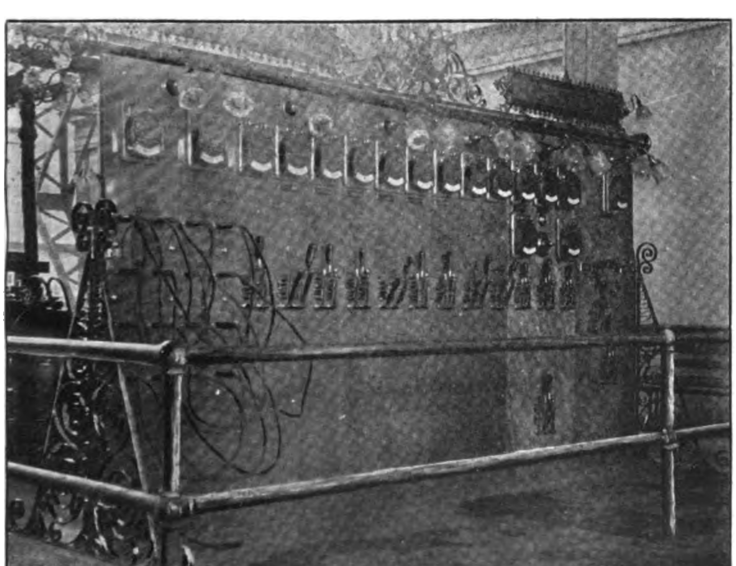
THE WESTERN ELECTRIC COMPANY AT THE WORLD'S FAIR.—II.—(*Concluded.*)

VI.

THE power plant of the Western Electric Company, situated in Machinery Hall may be divided into two sections, devoted, respectively, to the furnishing of current for the Exposition, and for the use of the company in the different parts of the exhibit. For the Exposition lighting ten 50-light Western Electric arc machines are employed. These furnish current to lamps in the Transportation and Anthropological Buildings and a portion of the Midway and the walks on the grounds. The lamps are of the double and single pattern, burning from 14 to 16 hours consecutively.

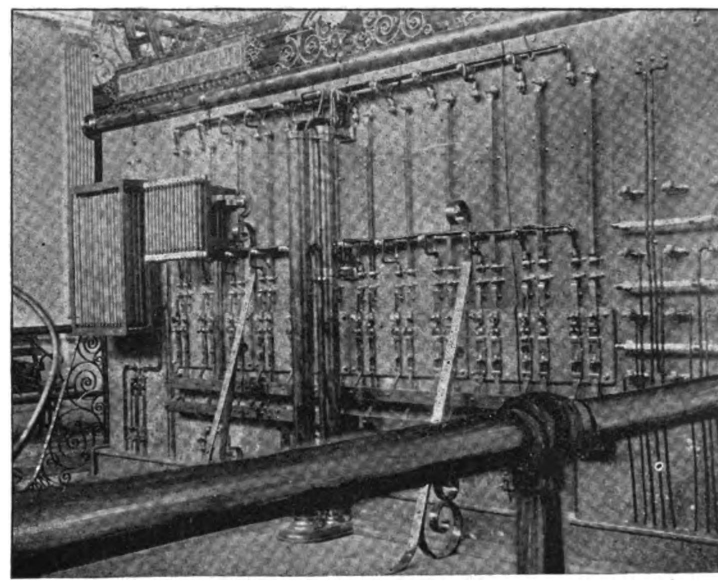
Four of these machines are driven by an engine built by the Watertown Steam Engine Company, of Watertown, N. Y., three by an engine of the Erie City Iron Works, of Erie, Pa., and three by a New York Safety Steam Power engine. All of these machines are provided with special switches so arranged that part of the field can be short circuited so that by throwing one switch the current can be reduced from 9.6 to 8 amperes, while the throwing of a second switch cuts the current down to 6.8 amperes. The switchboard to which all of the circuits from the machines are run is of Tennessee marble with japan-finished iron work and is 14 feet long, 6 feet high. Small as it is, it is amply large enough to handle 750 arcs and 400 h. p. of current for incandescent lighting. Its arrangement in general is similar to that of the distributing board placed within the Company's space in the Electricity Building, and which is illustrated on this page.

For its own display in Electricity Building the Company operates two 50-light arc machines driven by a 100 h. p.



DISTRIBUTING BOARD IN ELECTRICITY BUILDING, FRONT VIEW.

Russell engine and two 200 h. p. generators driven by two 200 h. p. Russell engines built by the Rice & Whitacre Manufacturing Company, of Chicago, and exhausting into Corliss heaters. These generators are 6-pole machines with Gramme rings and wound for 250 volts. All the belts in this plant were furnished by Messrs. Graton & Knight, of Worcester, Mass.



DISTRIBUTING BOARD IN ELECTRICITY BUILDING, REAR VIEW.

From the switchboard in Machinery Hall six No. 0000 wires of each polarity, or 12 in all, run to Electricity Building and are joined to the bus bars of the distributing board. The distance is in the neighborhood of 2,500 feet, and the wires run through a tunnel. In order to obtain the highest insulation the lines are not tied to the insulator, as usual, with tie wires, which are apt to injure the insulation, but are fastened by special clips made of zinc strips an inch wide and separated from the insulation by a layer of shellacked canvas. The result of the adoption of this method is that the 30,000 feet of wire, although passing through a wet tunnel, measures over a megohm when the wires are coupled in parallel. Insulation tests are made five times a day and a record kept for reference.

Besides the Exposition lighting above referred to the company have 75 arc lamps on the main floor and in the gallery of Electricity Building, suspended from ceiling boards, and 30 lamps hung in Columbian lamp posts, as illustrated in the engraving on page 349. These posts consist of an ornamental casting six feet high into which there is inserted a pole five inches in diameter, which is let down clear to the base and fastened to a socket so as to make it perfectly rigid. The wood serves as an additional insulator and for the fastenings of the pole steps. The hood is of the one arm pattern, the arm being placed towards the house so as to make all the light available for the illumination of the street. The upper portion of the hood is designed to receive the glass street signs which are illuminated at night. In the base is an iron door which opens to a double pole cut-out switch.

VII.

The switchboard employed for the distribution of the current to the various displays of the company in Electricity Building, is illustrated in perspective, in the engravings

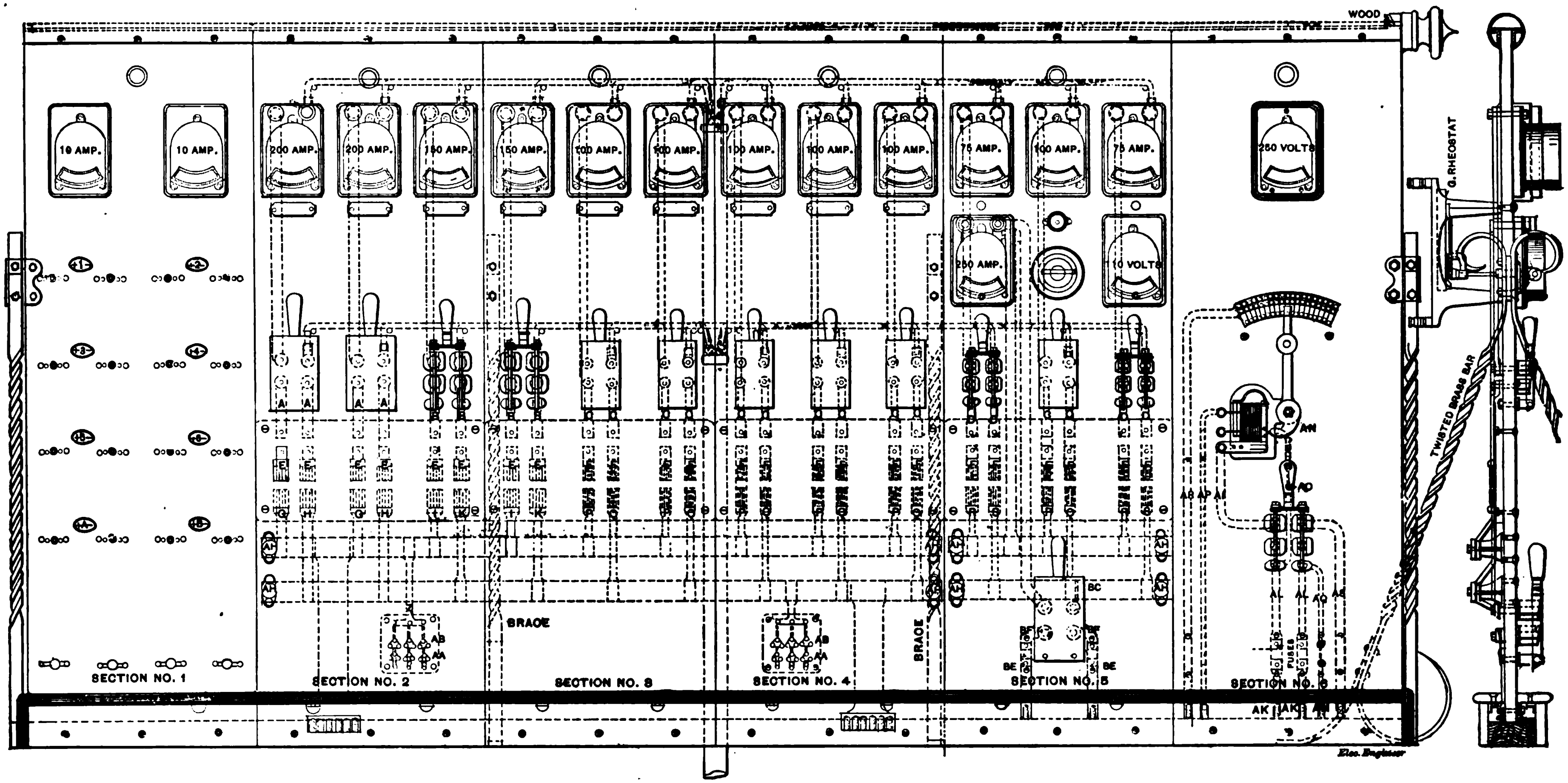


Diagram of Connections

of

Distributing Board

in

Electricity Building,

showing

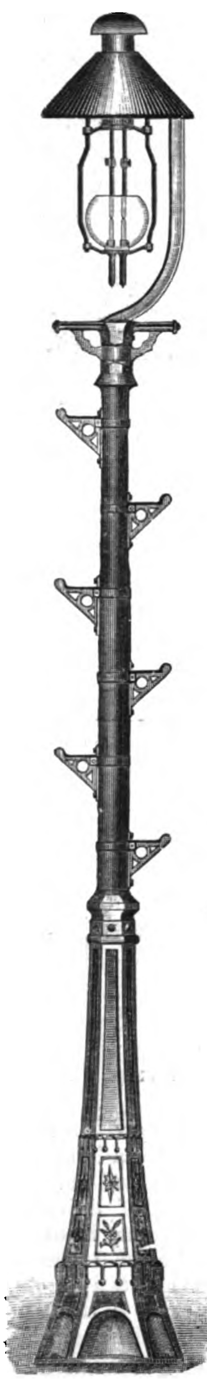
Automatic Self-Locking Motor Switch.

on page 347, and in detail on this page, and embodies all the latest devices for the safe and economic handling of the current. As will be seen, Section 1 of the board is devoted to the arc circuits and the plugs and connections are so arranged that the change of lamps from one circuit to another can be effected without causing any interruption in the current nor any flicker in the lamps. The remaining panels of the board are devoted to the switches and measuring instruments connected with the circuits for distributing light and power in the various spaces of the company, and the extreme right hand panel contains an automatic locking switch which prevents the full current passing through the armature of the large motor employed, until the latter has attained its proper speed. It also acts as an automatic cut-out as well as a starting rheostat, being so arranged that the machine cannot be started until all the resistances are in circuit.

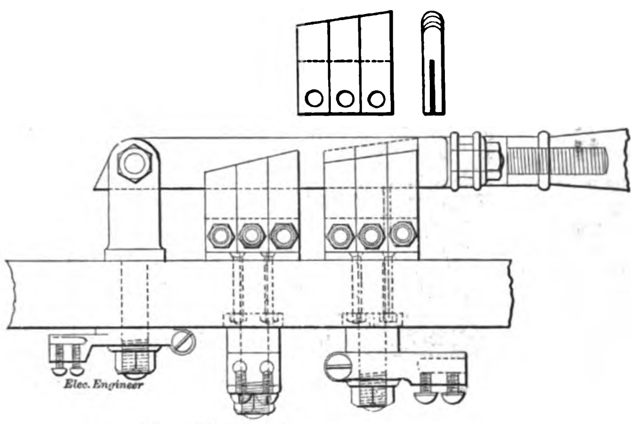
The motor switches attached to this board are also worthy of a short description. In order to obtain a constant and unvarying spring action the clips which grip the knife blades, instead of being solid, are slit, as shown in the engraving, on page 349, and are held in position by bolts passing through them. The clips are so spaced that when the knife blade is inserted they are slightly spread, the slit permitting them to recede a certain amount and to grip the blade firmly.

The Rudd ground detector which is applied to this switchboard and which is used on all the arc boards of the Western Electric Company, enables the attendant at the station to locate with the greatest ease and dispatch any ground which may come upon the circuit. The principle employed is the very simple one of the Wheatstone bridge and will be readily understood from the diagram on page 349. Here L represents a series of arc lamps fed from the

dynamo D. From the terminals of the machine in the station a shunt is taken through the switches S S, and led through a pair of condensers C C, and from a point between these two a circuit leads through the annunciator drop A to ground G. The annunciator drop is also connected by a local circuit with an electric alarm bell L C, which notifies the attendant of the fall of the drop. It is evident that if a ground should come upon any part of the circuit, the circuit established between it and the ground at the station G, tendant makes contact consecutively along the rheostat terminals and stops when the galvanometer needle stands at zero, showing that the bridge is balanced. The resistances indicated by the position of the plug P then correspond with the resistance on that part of the line included between the station and the outside ground and thus at once locate the fault. The safety resistance M, is included in the Wheatstone bridge circuit in order to prevent the destruction of the apparatus by an excessive current.



The Columbian Lamp Post.



The Multiple Contact Switch.

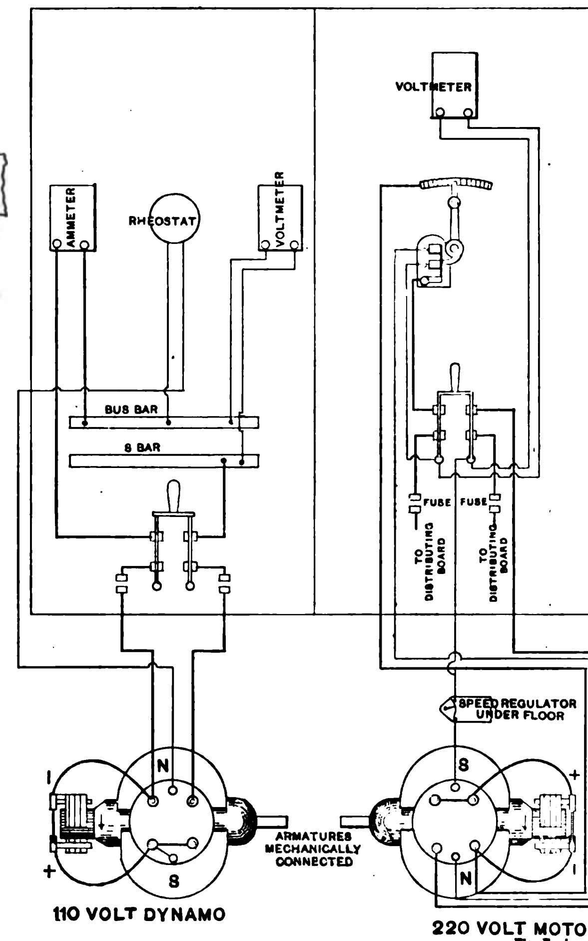
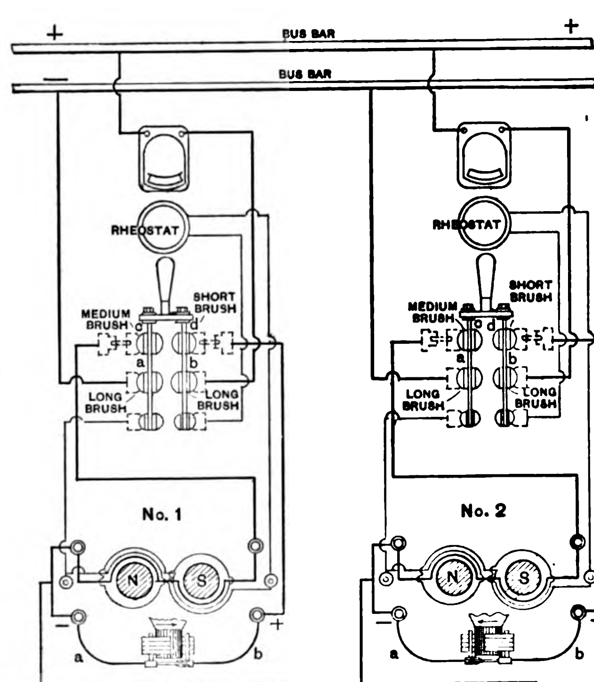


Diagram of Connections for Motor Generators.



Connections for Compound Dynamos in Parallel.

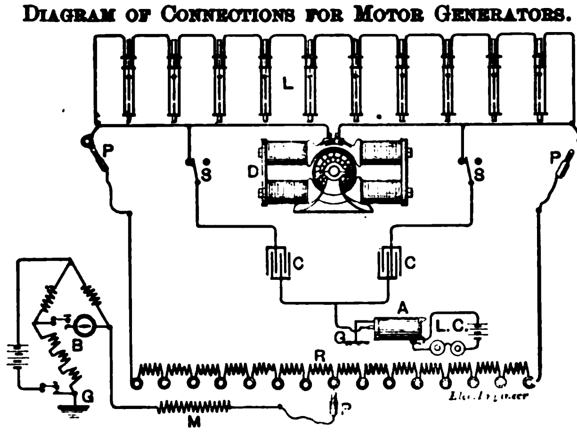


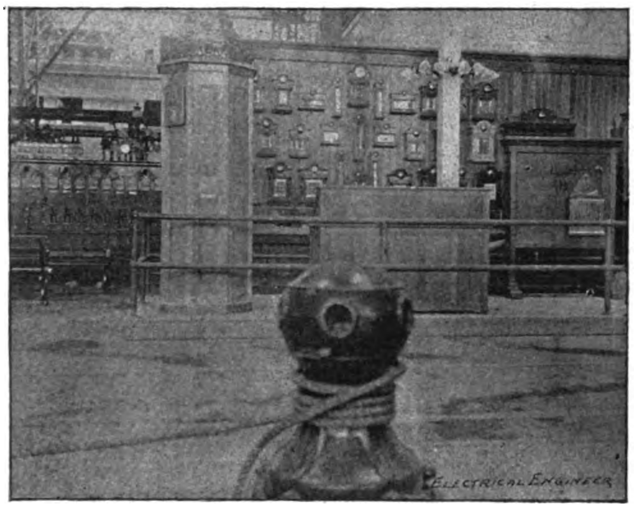
Diagram Showing Principle of the Rudd Ground Detector.

would cause the annunciator drop to fall and to sound an alarm. The attendant is thus notified of the occurrence of the ground. When this alarm is given the attendant inserts a pair of plugs P P, into suitable holes which connect the line circuit with a series of resistances R, each part of which corresponds in resistance to the resistance of a lamp and its portion of the outside circuit. Then by the aid of the Wheatstone bridge arrangement and a third plug P, the at-

The switches on this board are designed to properly handle by a single movement the circuits of compound wound motors, as a part of the current required in the operation of the Company's exhibit is furnished by two 220-volt compound wound motors directly coupled to two 110-volt dynamos. Their method of action is shown in the diagram on this page. In order to accomplish the throwing in of the series and shunt coils of the machines at the

proper times, the switches are so arranged that when the blade is thrown upward the two lower contact clips are first connected, which closes the circuit of the shunt coils in the field of the machine. Next, one of the two upper contacts is thrown in, closing the circuit of the series coils of the magnet, and finally, by another of the upper contacts the armature circuit is closed.

The annunciator, burglar, fire-alarm and police telephone exhibit, a partial view of which is given on this page, is particularly complete and comprises almost every known device of this type with all the latest improvements intended to insure accuracy of indication. Among the annunciators we find various types of house, hotel, car and



PART OF THE ANNUNCIATOR, BURGLAR ALARM AND POLICE TELEPHONE EXHIBIT.

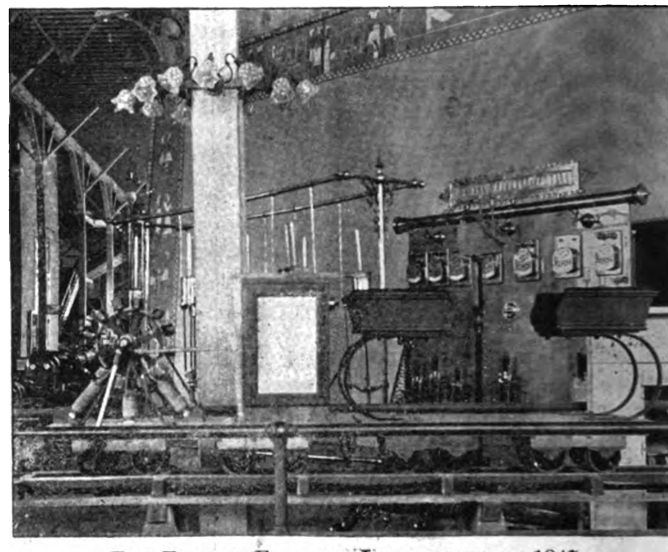
steamboat annunciators, and the collection presents an excellent illustration of the many uses to which electricity can be put for the protection of life and property.

VIII.

Among the ornamental and decorative features of the exhibit there are a number of illuminated signs and electrical effects which merit some attention. Among these is the column of light with its radiations of forked lightning which extend from the centre to the four corners of the exhibit as indicated in outline in the ground plan of

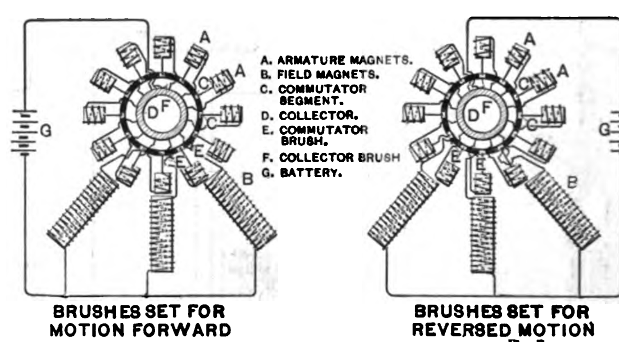
THE COLUMN OF LIGHT AND ARCH OF TUBING.

the exhibit, and which are partly shown in the engraving on this page. The column of light, placed in the centre, has red, white and blue lamps placed in horizontal rows; the radiating lightning flashes are similarly equipped. The visitor beholds the light rising from the base of the column to the top and then quickly, as it were, dissipating



THE FARMER ELECTRIC LOCOMOTIVE OF 1847.

itself to the four corners of the exhibit where it loses itself in revolving globes of colored lamps. In order to give the observer the idea that the flash proceeds more quickly, as it radiates from the centre, an ingenious arrangement of the circuit has been adopted. This consists in grouping the lamps in the radiating arms so that at the main or central column of light, they light up in groups of six, then in groups of four and finally in groups of two. The lamps are wired with independent positive circuits, but all have a common negative return. The revolving spheres at the



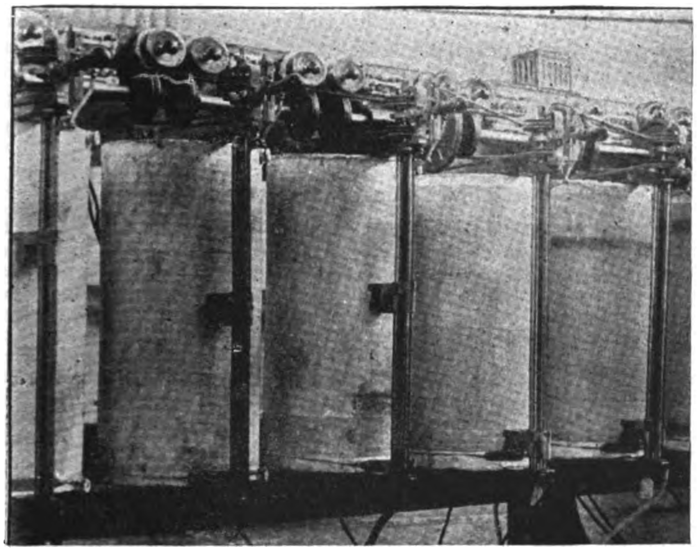
CONNECTIONS OF FARMER ELECTRIC LOCOMOTIVE.

four corners of the exhibit have the lamps arranged similarly to the circles of longitude and have red, white and blue lamps which are consecutively thrown into circuit and give the appearance of a continually changing sphere of light.

The apparatus by which this effect of the traveling light is obtained consists of a revolving switch placed close to the column of light and covered by a glass frame so that its apparatus can be seen from above. The lamps, in order to light up consecutively, are connected to a revolving switch consisting of an iron spider cylinder with hard rubber adjustable cams which throw the respective switch levers into contact; these levers have carbons at their contact ends and the spark is blown out by an air blast. This switch cylinder weighs 700 pounds, but being mounted on roller bearings requires only a very small power to drive it.

The tower of light contains no less than 2,600 lamps and the revolving spheres at the four corners of the exhibit each contain 96 lamps. Notwithstanding the hard usage to which the lamps have been subjected for the past five months, first by their lighting and extinguishing every few

seconds, and, in the case of the revolving spheres, by their continual motion, but a very small percentage has failed. This result may possibly be due to the fact that the direction of the current in the lamps is reversed on consecutive days.



AUTOMATIC RHEOSTAT IN THE SCENIC THEATRE.

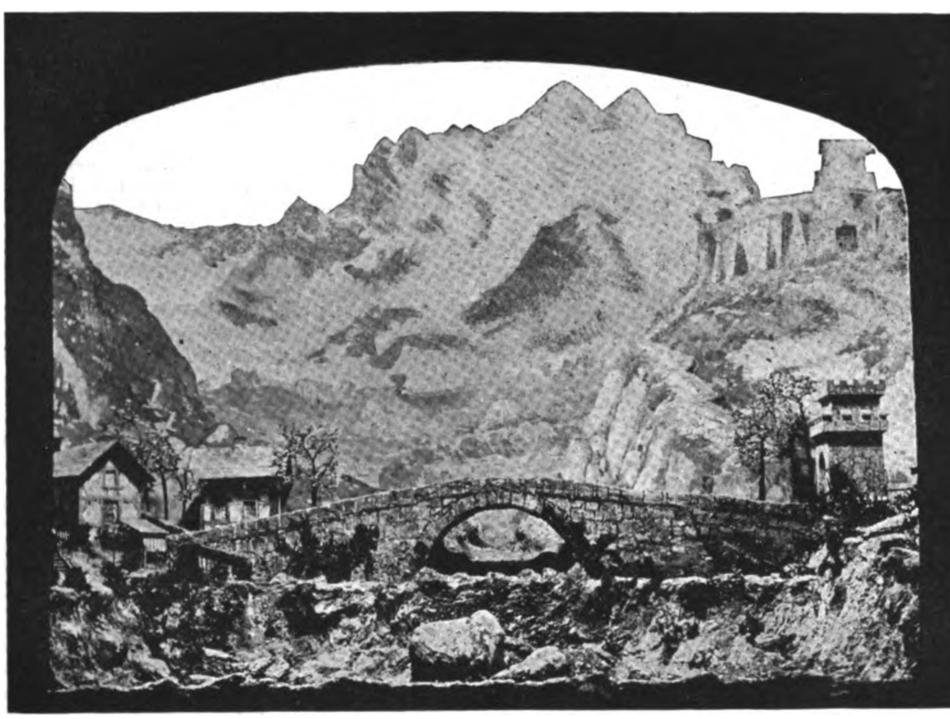
One of the illuminated signs, that at the northwest end of the exhibit, is 22 feet long, 4 feet wide and 6 feet high. It is made up of two pieces of plate glass with cardboard on the outer side in which are cut the words, "Western Electric Company, Chicago, New York, London, Berlin and Paris." The letters appear in red, green and blue and the light from the interior passes through crushed flash glass of these respective colors; as the light strikes this glass the rays are broken in all directions. Within this sign are 14 arc lamps hung on a frame which is rocked by a ¼ h. p. motor. The continual change of position of the lamps causes the light passing through the crushed glass to have a scintillating effect which is most pleasing to the eye. The sign is also adorned with excellent portraits of Faraday, Ohm and Ampere on one side and of Franklin, Volta and Henry on the other.

Another sign at the southeast corner of the exhibit is made up of ruby jewels with 20 arc lamps placed behind them. The globes of these lamps are half silvered and act as reflectors to concentrate the light. These lamps are run by a 15 h. p. motor driving a 20 arc light machine placed directly under the sign.

IX.

With due regard for the historical side of the art, the Company have placed on exhibition a number of interesting reproductions of the work of the late Prof. Moses G. Farmer. Among these we find reproductions of the Farmer incandescent lamps of 1859. The platinum filaments are enclosed within a glass cylinder 1¼ inch in diameter and 3 inches high covered with a brass top; spring clips hold the filament in position. Two lamps of this type are mounted on the original mantel-piece taken from Prof. Farmer's old home. Close beside this is a small dynamo with drum armature and shunt field, the original one built by Prof. Farmer and in which he applied the principle of self-excitation, which he discovered independently of Siemens and Wheatstone.

Here also is shown a reproduction of the street car motor built by Prof. Farmer in 1847, page 350. The arrangement of the motor will be understood from the diagram on the same page, which shows the circuits. It consists of three horse shoe field magnets B which act upon an armature consisting of 12 horseshoe magnets A, the poles of which pass close to those of the field magnets. C are the commutator segments, D the collector, E E E the commutator brushes and F the collector brush. The arrangement is such that the current from the battery G passes continually through the field magnets B coupled in parallel, and is then led to the commutator brushes E E, which energize three of the armatures A when they are in the most favorable position to be attracted. The spindle of the motor drives the car axles through intermediate bevel gear. The exhibit also includes the portrait of Prof. Farmer, painted by Tompkins, a reproduction of which appeared in THE ELECTRICAL ENGINEER of June 7, 1893. The battery exhibit of the Company



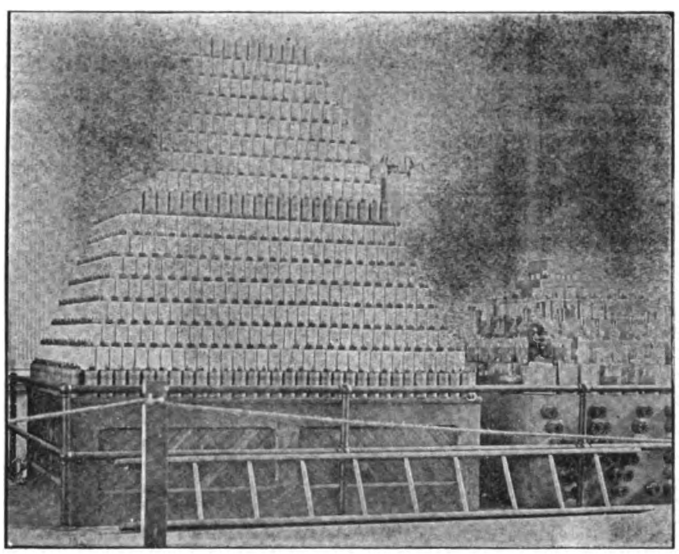
ALPINE LANDSCAPE IN THE SCENIC THEATRE.

includes every variety of cell used in practice to-day both of the open and closed circuit type and our engraving on this page shows two pyramids of batteries forming part of this exhibit.

X.

The variety and interesting nature of the exhibits in the various sections of the Company's exhibit serve to attract numerous visitors, but there is probably no other one feature in the Electricity Building, or, for that matter in any other building on the entire Exposition grounds, which attracts more visitors than does the Scenic Theatre in which the Company have sought to give the public an idea of what electricity is capable of doing in the way of theatre lighting and theatrical effects. It was at first intended to show this in a small space in which a score of people would be able to find standing room at one time, but luckily this plan was changed and the scenic theatre was equipped with a seating capacity of 150 persons and standing room for probably 50 more.

The scene, pictured on page 351 is an Alpine landscape with farm houses in the foreground and towering mountains in the rear, with a bridge spanning a babbling brook and lighted by electric lamps placed in miniature lamp posts. The audience, during the 15 minute performance is passed through a period of 24 hours from 8 P. M. of one



PYRAMIDS OF BATTERIES.

day to the same time of the next day. Starting with sun down, darkness comes on, the lights in the houses and on the bridge light up and are presently extinquished to give way to a beautiful dawn effect which gradually increases to brilliant day light. Presently, again, the scene becomes overcast, the effect of at hickly clouded sky being produced and lightning flashes of the most vivid and realistic kind pierce the upper regions of the atmosphere. When the storm is past, a beautiful rain bow spans the distant mountains and heralds the approach of sunlight. This is followed by sundown and the rising of the moon.

Naturally all of these effects are produced by the manipulation of lamps, but the gradations of light are so well carried out that the illusion is perfect For this purpose rheostats have been constructed of the type shown in our engraving on page 351, which are operated by a small motor. By throwing a lever the wheel controlling the rheostat wires can be made to cut resistances in or out as desired. Not the least interesting part of the arrangement is the effect which is produced by a traveling bank of lamps which make the shadows on the scene before the eyes of the audience appear tó change just as they would do in reality as the result of the constantly changing position of the sun.

We have sought in the above to convey to the reader a general idea of what is comprised within the exhibit of the Western Electric Co. at the World's Fair. To adequately describe it would fill a good sized volume, but brief as we have been forced to be, enough, we believe has been said to demonstrate the magnitude and variety of the company's work. This description would not be complete without mention of Mr. W. R. Patterson who laid out the design of the exhibit and of Mr. A. L. Tucker who has superintended its construction and operation, and who has charge of the exhibit.

SOME ELECTRICAL STATISTICS OF CHICAGO DAY.

ABOUT 800,000 people were at the World's Fair on October 9, Chicago Day, to celebrate the memorable anniversary of the destruction of the metropolis of the West by fire; and it is needless to say that grounds and buildings were crowded to suffocation. Even on the beautiful lawns it might be said that the signs "Standing room only," were taken down, for it was impossible to make a short cut across the broadest of the expanses of turf which usually lie fair and green between the buildings. Under such circumstances there was a great strain upon the means of transportation, although in such a crush wheeled chairs were of little use except to sit and rest in, and the gondolas appeared, with their heavy loads, to be slower than ever. Thus it was that electricity bore off the honors of the day. The Intramural third rail trolley road was tremendously crowded all day long. The previous best record was about 80,000 passengers, but on Chicago Day the number ran up to 125,833, and this total did not include many more who would have ridden had they been able to reach the platforms. There were 15 four-car trains, running, and the motors stood up to their work wonderfully well. The faint odor of shellac told once or twice that they were warm and tired at the end of the day, but the service was maintained without any interruption from 6.45 a. m. to 11 p. m. The motormen were utterly fagged out. The people swarmed all over them, and I saw one skillfully running his locomotive with his arm around the neck of a woman who had interposed her head between him and the switch handle. I am informed that the output at the generating plant averaged about 1,000 amperes throughout the day, and was kept up at very near that figure from start to finish.

On the water, the launches were not less useful and successful. All fifty were in operation, and 20,648 people made the tour of the water in them, which would mean receipts of about $10,000 for the day, whereas the total has probably not exceeded $6,000 on any preceding day. Towards evening the boats were in some instances running rather slowly. I was in one about 10 o'clock which just about managed to make her landing, when the pilot declared he could get no more out of her. But the service throughout was admirable and highly satisfactory, and the public enjoyed a lesson that it is not likely to forget, as to the advantages of electrical navigation.

The other parts of the electric service were also severely tested. Every lamp in every building or around it was burning until late at night, and the engineers of all the generating plants report that the output was larger than ever before. The police and signal system was in incessant requisition, and the ambulances alone received and answered 160 calls from all parts of the grounds. I learn from the Western Union Co. that its offices were also very busy.

During the evening a fine parade of floats was given, one of the principal features of which was the gigantic dragon of the Edison and General Electric Companies, with lamps all over its body, and steam issuing from its nostrils. Some of the other barges also had various electrical illuminations.

ADDITIONAL AWARDS AT THE WORLD'S FAIR.

UNITED STATES.

General Electric Company; The Thomson lightning arrester.

Queen & Co.; Cable testing set, conductivity apparatus.

Westinghouse Electric and Mfg. Co.; High tension experimental apparatus, automatic carbon shunt circuit breaker.

Otis Brothers & Co., New York; High pressure hydraulic elevator engine, standard hydraulic elevator (passenger), compound hoisting engine, electric passenger elevator, general exhibit of elevators.

Morse, Williams & Co., Philadelphia; Electric passenger elevator.

Multiple Speed and Traction Co., Chicago; Double moving sidewalk.

Bemis Box Car Co., Springfield, electrical motor truck.

Robinson Electric Truck and Supply Co., Boston; Electric radial truck.

Coburn Trolley Track Manufacturing Co., Holyoke; Overhead carrying track.

Washburn & Moen, Worcester, Mass; Cables for street railways.

Johnson Co.. Johnstown, Pa.; Street railway appliances.
Robinson Machine Co., Altoona, Pa.; Electric car truck.
Westinghouse Electric and Mfg. Co., Pittsburgh; Street railway electric car equipments.
E. H. Wilson, Philadelphia; Open and closed vestibuled street cars.
Columbian Intramural Railway Company, Jackson Park; Electric elevated railway.
Pullman Palace Car Company, Chicago; Single and double deck street car.
William Wharton, Jr. & Co., Chicago; Rails, fittings and special work for street railways.
International Register Co., Chicago; Conductor's portable register.
McGuire Mfg. Co., Chicago; Trucks.
Genett Air Brake Co., Chicago; Air brake equipment for electric and cable railway street cars.
J. M. Jones' Sons, West Troy; Body open electric car, body closed electric car.
John Stephenson Co., New York; "Broadway" cable car, electric motor car.
Peckham Motor Truck and Wheel Co., Kingston; Electric motor truck.
James H. Stedman, Rochester; Detective transfer.
S. S. White Dental Mfg. Co., Philadelphia.
Jeffery Mfg. Co., Columbus, O.; Electric coal mining machines, electric rotary coal drill and ironclad motor, air power rotary coal drills.
Roessler & Hasslacher, New York; Collective exhibit of chemical products. Roessler & Edelman's desilvering process.
Western Mineral Wool Co., Chicago; Display of mineral wool.
Pittsburgh Reduction Co., Pittsburgh; Collective Exhibit showing metallurgy of aluminum.
Trenton Iron Co., Trenton, N. J.; Iron and steel wire, telephone and telegraph wire, spring weaving transparent steel and music wire.
Washburn & Moen, Mfg. Co., Worcester, Mass.; Round wire springs, flat steel springs, round, angular and convey card wires.

GERMANY.

Felten & Guilleaume; Wires and cables.

MISCELLANEOUS.

TELEPHONY AND POWER TRANSMISSION LINES IN CALIFORNIA.

A FEW weeks ago we published a very interesting article by Mr. G. P. Low on the Pomona, Cal., high tension power transmission. We have now received the following communication from Mr. L. E. Imlay, of the San Antonio Light and Power Company, of Pomona, Cal., on the effect produced by the lighting current on the service telephone lines that are adjacent:

"I think that our experience in operating the telephone in connection with our long-distance transmission plant, may be interesting to those who are studying the effect of current induction between electric light and telephone wires. Our power station is situated in San Antonio Cañon at a distance of 28 miles from San Bernardino and 14 miles from Pomona, both of which places are lighted by us. The two circuits follow the same pole line and are located on the same cross-arms for a distance of six miles, and then one branch extends west to Pomona and the other east to San Bernardino. The maximum current is 11 amperes at 10,000 volts, of which about seven amperes are supplied to San Bernardino and four amperes to Pomona.

"The telephone circuit is of galvanized iron wire No. 14 S. W. G., and is operated with ground return. The wire is strung on the same poles with the light wires about six feet below the cross-arms. No attempt was made to compensate for induction by changing the line from one side of the pole to the other, but it was put on the most convenient side. The resistance of the telephone wire is approximately 90 ohms per mile. There is no loop, the three wires being simply connected together at the junction six miles from the power house. There is a telephone at each of the sub-stations and one at the power station.

"When no current is on the light wires, the telephone operates perfectly even when the three instruments are in use. When the lighting current is on, there is a very decided hum in the telephone, but conversation over the 14 miles line is easy and quite satisfactory. Over the longer line it is possible to communicate whatever is necessary, but it would be difficult to carry on an extended conversation.

"It is unnecessary to state that highly insulated foot stools are used to stand on when conversation is carried on during lighting hours. We are very much pleased with the results inasmuch as we were informed by high authority that conversation would be impossible when the lighting current was on."

ELECTRIC POWER PLANS FOR TRENTON, N. J.

FORTY years ago, a pet hobby of Abram S. Hewitt, who then lived in Trenton, N. J., was, says the New York *Evening Post*, the project of constructing a dam across the Delaware at that point in order to utilize the water-power for manufacturing purposes. It now seems about to be realized, but electric instead of water-power will be developed, a company having been organized to build a wing dam, with a complete outfit of sluiceways and turbines for the generation of power. The works will be located at Morrisville, and the power will be sold to Trenton shops and factories. At the last session of the Legislature a bill was passed authorizing the construction of dams half way across the river, when the State of Pensylvania should agree to co-operate. Objections came, however, from lumber interests on the Pennsylvania side and from the city of Philadelphia, which had been considering a plan to get its future water supply from the Delaware above Trenton. These objections were satisfactorily met, and the company was recently incorporated with a capital of $500,000. Work on the dam will be started about the latter part of this month. Among other things which the company is empowered by its charter to do are the following: "To erect and maintain mills, factories, ice-houses, dwelling-houses, power-houses and plants; to erect and maintain dams and reservoirs for the storage of water for the purpose of power; to supply power for mills and factories and electrical power-houses and plants and water-wheels; to erect and lay cables and wires overhead, under water and under ground for the transmission of electricity; to manufacture, sell, furnish, rent and lease all kinds and manner of power and machinery for the carrying on of all kinds and manner of mechanical business, mining, street-railways and tramways, and to acquire franchises and privileges for such purposes."

THE POLICE SIGNAL SYSTEM OF WARSAW.

THE Nauvoo, Ill., *Rustler*, says that the Warsaw Electric Light Company and the police of that city work together to catch suspicious looking characters at night. The electric light plant is located on the levee, and at night when the engineer in charge sees a tramp or bum coming down the railroad track or loafing on the levee, he turns the switch which puts out all the lights in the city for a second. The night policeman takes his cue from this and goes to the levee and makes the arrest.

BURSTING OF A FLY-WHEEL IN BROOKLYN.

FROM some unexplained cause one of the fly-wheels in the power house of the Atlantic Avenue Railroad at Third avenue and Second street, Brooklyn, N. Y., burst on the evening of Oct. 11. The wheel was 18 feet in diameter and weighed 20 tons. Part of the fragments passed through the roof and lodged at some distance from the station. Two persons were injured by the accident, but fortunately not fatally. The road was delayed only two hours when current was obtained from the City Railroad Company. The damage, it is said, will exceed $20,000.

MR. JOHN STARR.

WE had the pleasure of a call from Mr. John Starr, of John Starr & Co., Halifax, N. S., on Friday last. Mr. Starr was on his way to England—intending to sail on the "Lucania," Saturday, October 14,—where he will remain for a short time.

SOCIETY AND CLUB NOTES.

FRANKLIN INSTITUTE LECTURES.

THE FRANKLIN INSTITUTE has published its announcement and programme of lectures for the season of 1893 and 1894, extending from November 3 to March 23 inclusive, and commencing at eight o'clock in the evening of each Friday between these dates. Among the long list of interesting subjects are "Induction Coils and Condensers," by Prof. Elihu Thomson, on Dec. 22, and "The Electric Motor," by Prof. F. B. Crocker, on Jan. 19. Prof. Houston will open the course on Nov. 3, with a lecture on "A Plea for the Study of Forestry in the Lower Schools."

CLEVELAND ELECTRIC CLUB.

AT the recent annual meeting of the Cleveland Electric Club, president C. W. Wason read his report of the proceedings of the past year and also the treasurer's report. These showed the club to be in a flourishing condition socially and otherwise. The election of officers for the ensuing year resulted as follows: President, C. W. Wason; first vice-president, C. W. Foote; second vice-president, C. F. Uebelacker; secretary, H. J. Davies; treasurer, James C. O'Neil; board of managers, E. P. Roberts and P. Yensen.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 3, 1893.

Alarms and Signals:—

Fire Alarm, A. Krastin, Cleveland, O., 505,884. Filed Jan. 6, 1893.
A thermostatic fire alarm for buildings.

Fire Alarm System, H. T. Downs, New York, N. Y., 505,819. Filed Oct. 1, 1892.
An automatic alarm system transmitting from a common station to various outlying stations.

Conductors, Conduits and Insulators:—

Insulating Joint, S. W. Burtchaell, San Francisco, Cal., 506,084. Filed June 20, 1892.
A joint adapted to gas fixtures and house pipes.

Insulating Support for Metallic Circuits, A. C. Cousens, Boston, Mass., 506,002. Filed May 6, 1893.
The invention consists in insulating the two wires of a metallic circuit from a conducting support common to each, and insulating the supports from a main support.

Insulating Compound and Method of Manufacturing the Same, J. Hoffman, Schenectady, N. Y., 505,916. Filed Dec. 2, 1892.
Consists of asbestos fibre, asphaltum, beeswax and shellac.

Distribution:—

System of Electrical Distribution, C. F. Scott, Pittsburgh, Pa., 505,928. Filed Sept. 28, 1892.
Employs two potential modifiers having their primary circuits in multiple arc with the main line and their secondaries in series on each side thereof.

Dynamos and Motors:—

Electric Elevator, E. R. Esmond, New York, N. Y., 506,169. Filed Feb. 21, 1893.
Employs a rotatable field and rotatable armatures and a hoisting drum mounted on the field.

Armature, M. Rahner, Union, N. J., 505,957. Filed Dec. 7, 1892.
Especially designed with a view to removing any one coil without disturbing the others.

Alternating Current Generator, A. Schmid, Pittsburgh, Pa., 505,927. Filed Nov. 3, 1892.
Employs a compensator mounted on the armature and having a magnetic circuit independent of the armature.

Armature for Electric Machines, A. Schmid, Pittsburgh, Pa., 505,926. Filed Nov. 3, 1892.
Consists principally in the method of constructing and supporting the pole pieces.

Regulator for Dynamos, W. H. Elkins, Cambridge, Mass., 505,914. Filed Nov. 21, 1892.
Employs a regulating brush with means for moving one of the main brushes toward and from the regulating brush, and an external circuit one terminal of which is directly connected to the main brush and also to the regulating brush and which contains the whole field and all the translating devices.

Alternating Current Motor, W. Stanley, Jr. and J. F. Kelly, Pittsfield, Mass., 505,859. Filed June 8, 1892.
A two-phase motor having independent energizing circuits, a main circuit from a source of alternating current, a transformer, the primary and secondary coils of which are in circuit with the motor coils respectively, and a condenser in series with the secondary coil and one of the motor coils.

Lamps and Appurtenances:—

Incandescent Electric Light, H. D. Burnett, Lynn, Mass., and S. E. Doane Swampscott, Mass., 505,913. Filed June 27, 1892.
Relates to a method of securing the contacts for the leading-in wires.

Metallurgy:—

Process of Separating Metallic Nickel, P. De P. Ricketts, New York, 505,-846. Filed April 20, 1892.

Miscellaneous:—

Means for Determining the Presence and Intensity of Atmospheric Electricity, J. Opperman, St. Louis, Mo., 506,066. Filed Feb. 15, 1893.

Device for Preventing Boiler Incrustation, A. B. Faunce, Quincy, Ill., 505,942. Filed July 28, 1892.
The invention includes a feed water pipe provided on its interior with positive and negative plates and means for keeping the zinc and copper bright and clean.

Cleat for Holding Insulated Electric Wires, E. W. Buffington, Fall River, Mass., 505,912. Filed June 1, 1893.
Employs a base provided on its upper surface with transverse ribs located directly over the part crossed by the wires.

Rheostat, A. Wurts, Pittsburgh, Pa., 505,911. Filed Dec. 29, 1892.
Employs resistance strip composed of wire gauze or netting.

Apparatus for the Electrolytic Production of Soda and Chlorine, E. B. Cutten, New York, N. Y., 505,895. Filed Dec. 30, 1891.
Relates to the manufacture of chlorine and caustic soda by the electrolytic decomposition of common salt.

Method of Working Condensers, W. Stanley, Jr., J. F. Kelly and C. C. Chesney, Pittsfield, Mass., 505,860. Filed March 18, 1893.
Interposes in the condenser circuit a dead resistance which is short circuited during the normal working of the translating device with which the condenser is used.

Protector for Pipes from Powerful Electric Currents, F. Egner, St. Louis, Mo., 505,822. Filed June 17, 1893.
Consists of a combination of wires of better conducting material than the pipes laid along in contact with the latter and connected with earth plates.

Railways and Appliances:—

Electric Trolley Wire Crossing, E. P. Binford, Cincinnati, O., 506,149. Filed Nov. 3, 1892.
Employs a swinging metallic bridge operated by the trolley so that electrical connection is uninterrupted as the wheel passes the joint.

Electric Railway System, H. A. Lewis, Norristown, Pa., 506,134. Filed March 3, 1893.
Claim 1 follows:
The combination with the trolley bar with alternating conducting and non-conducting surfaces, of a trolley wheel mounted to move in contact with said bar, vertically disposed coils energized from said bar, and horizontally disposed armatures mounted to be engaged by the coils.

Trolley Wire Support, M. Hoopes and O. S. Hertzog, Lynn, Mass., 506,043. Filed July 1, 1893.
A bracket arm having a wire stretched between its outer end and its supporting post for the purpose of holding the trolley hanger.

Controlling Device for Electric Railway Cars, W. P. Coldren, Lebanon, Pa., 506,001. Filed April 22, 1893.
Relates to means for controlling the current and operating the brake simultaneously.

Electro-Conducting Bearing for Trolley or other Wheels, Elmer A. Sperry, Chicago, Ill., 505,994. Filed Sept. 17, 1891.
Employs a bushing and collars of commutator brush carbon.

Conduit Electric Railway, L. A. McCarthy, Brooklyn, N. Y., 505,841. Filed Feb. 6, 1893.
Employs a sectional conductor making contact with the trolley wire through the action of a magnet carried by the car.

Contact for Signaling to Cars, F. E. Kinsman, Plainfield, N. J., 505,833. Filed May 26, 1892.
Relates to means for controlling the movements of electric cars automatically without intervention of the motorman.

Switches and Cut-Outs:—

Electrical Switch, C. O. C. Billberg, Philadelphia, Pa., 506,092. Filed July 28, 1893.
Employs a series of carbon contact plates connected through resistances and a switch lever carrying carbon contacts.

Electric Time Cut-Out, F. Beland, Cairo, Ill., 505,808. Filed July 8, 1893.

Telephones and Apparatus:—

Transmitting Telephone, S. W. Holman, Boston, Mass., 505,917. Filed May 4, 1893.
Employs a liquid electrode consisting of a thin stratum of conducting liquid adhering to a conducting surface, and one or more solid electrodes vibrating in the liquid stratum.

REPORTS OF COMPANIES.

ANNUAL MEETING OF THE WESTERN UNION TELEGRAPH CO.

AT the annual meeting of the stockholders of the Western Union Telegraph Company, held on Oct. 11, Gen. Louis Fitzgerald and Messrs. George Bliss, John Jacob Astor, C. Sidney Shepard, Oliver Ames (2d), and J. B. Van Every were elected directors. Messrs. Sidney Shepard and Erastus Wiman declined re-election, and the other vacancies were caused by the deaths of former directors.

The annual report for the year ended June 30 shows:

	1893.	1892.		Changes.
Gross earnings	$24,978,442	$23,706,404	Inc.	$1,272,018
Operating expenses	17,482,405	16,307,857	"	1,174,548
Net	$7,496,037	$7,398,547	Inc.	$97,470
Interest and sinking fund	933,377	930,523	"	2,854
Balance	$6,562,660	$6,468,024	Inc.	$94,636
Dividends	4,631,819	4,309,638	"	322,181
Surplus	$1,930,841	$2,158,386	Dec.	$227,545
Total surplus	6,886,819	13,576,127	"	6,689,308

The balance sheet it as follows:

	1893.	1892.		Changes.
Accounts payable	$3,087,629	$2,924,8°3	Inc.	$163,246
Cash	1,451,536	2,202,275	Dec.	750,739
Net floating debt	$1,636,093	$722,108	Inc.	$913,985
Accounts receivable	1,855,670	2,088,599	"	232,929
Supplies	407,306	252,721	"	154,585
Real estate	4,925,821	3,313,918	"	1,611,903
Stocks and bonds owned	7,709,713	7,627,559	"	82,154

The following statement shows the increase in the business of the company in the past three years with the number of messages sent and the cost of each:

	1893.	1892.	1891.
Miles of wire	769,201	739,105	715,591
Offices	21,078	20,700	20,098
Messages	66,591,858	63,387,298	59,148,343
Average tolls per message	31.2c.	31.6c.	32.5c.
Cost per message	22.7c.	22.3c.	23.2c.

The report says:

"The increase in expenses was $698,407 on account of the increased messages handled, $421,466 on account of maintenance, and $92,408 for miscellaneous improvements. The company holds $5,180,000 of capital stock in the treasury, in addition to the $28,790 which belongs in the treasury. The expenses were composed of the following items: Operating and general expense, $12,497,463; rentals of leased lines, $1,660,427; maintenance and reconstruction of lines, $2,517,246; taxes, $412,300, equipment of offices and wires, $394,967.

"There were added to the company's system during the year 360 miles of poles, 30,096 miles of wire, and 378 offices. The cost, amounting to $1,267,176, was paid out of surplus. An outlay of $1,612,500 for the remodeling of the company's building at Chicago was also paid out of surplus. The new mileage includes four copper wires from New York to Chicago, one from Chicago to Denver, and one from New York to New Orleans, by way of Washington and Cincinnati."

PERSONAL.

MR. PATRICK B. DELANY left for Europe, on the *New York*, on October 11. Mr. Delany expects to be gone for a year.

Trade Notes and Novelties

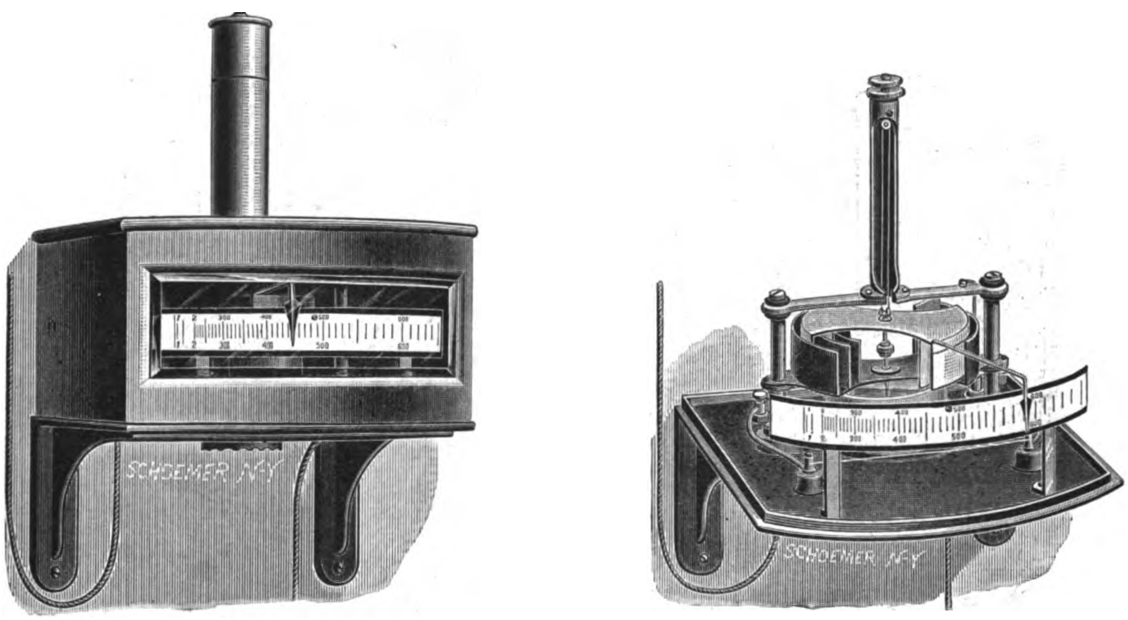
AND MECHANICAL DEPARTMENT.

THE KENNELLY STANDARD ELECTROSTATIC VOLTMETER.

THIS instrument is intended for use in central stations, and to be secured permanently in an upright position against wall or switchboard. It can be used on either continuous or alternating current circuits, and is made in two sizes indicating up to 600 and 1,150 volts respectively.

The instrument, shown in two views in the accompanying engravings, is very simple in design, and, working entirely on electrostatic principles, takes no current. A horizontal aluminum vane is suspended bifilarly, and carries vertical sectors of the same metal which travel freely in curved brass grooves. The vane and sectors are electrically connected through the suspension wires with one side of the circuit, and the brass grooves with the other, so that the E. M. F. sets up an electrostatic attraction between these parts, and the sectors enter the grooves, twisting the suspension wires until arrested by gravitational force.

The vane and sectors carry a horizontal pointer of 6 inches radius over the curved face of a scale 8 inches long, and the index points to the E. M. F. supplied to the instrument terminals. On the scale of the 600-volt instrument intended for use on 500-volt circuits, a variation of five volts, or one per cent. at load, makes a change of about one-eighth of an inch.



THE KENNELLY STANDARD ELECTROSTATIC VOLTMETER.

As the vane and grooves are connected directly across the bus bars, any accidental metallic contact between them would produce a short circuit. To prevent this the walls of the grooves are heavily japanned so that contact with the vane allows no spark to pass. As an additional security a fuse of fine wire is added within the case. The vane suspension terminates beneath in a light metallic damper immersed in non-evaporating oil, so that the movements of the pointer are practically deadbeat.

As the instrument simply measures electrostatic force against gravity, there is nothing within its action liable to change with time, and there are no pivots to introduce friction. The advantage of a bifilar suspension is its independence of torsion and such errors as temperature or elastic fatigue in wires are capable of producing.

The base and frame of the instrument are of cast iron, the cover of polished wood, and the front of beveled glass. The instrument is a handsome ornament to a switchboard. Its height above base is 11 inches, breadth 14½ inches, and projection from the wall 13 inches. It is unaffected by magnetic fields or temperature, or moderate vibration, or belt electrification. It has undergone satisfactory trials during the past 18 months. The instrument is manufactured by the Edison Manufacturing Company, of 110 East Twenty-third street, New York city.

THOMSON ELECTRIC WELDING AND PROJECTILE CO.

The general offices of the Thomson Electric Welding and Projectile Co. have been moved from the Fiske Building in Boston to its works at Lynn.

ELECTRIC CONSOLIDATION IN CANADA.

THE CANADIAN GENERAL ELECTRIC COMPANY, LTD., of Toronto, have purchased from the Ball Electric Light Company, Ltd., their entire electric manufacturing business, and will continue the manufacture of "Ball" apparatus at their extensive Peterborough works, including their new "1893" model arc lamp, which offers great simplicity and reliability of working either for constant current arc circuits, or direct or alternating constant potential incandescent circuits.

Mr. W. A. Johnson, late manager of the Ball company, will be connected with the purchasing company as head of the arc lighting department, as well as giving special attention to other recently manufactured and special apparatus.

THE MICHIGAN ELECTRICAL NOVELTY COMPANY'S SIGN.

THE MICHIGAN ELECTRICAL NOVELTY COMPANY, of Port Huron, Mich., have introduced an electric illuminated sign, the invention of Mr. A. L. McCormick, president of the company. It consists of transparent letters or parts in front of a number of series of electric lamps of different contrasting colors, portions of the design being separated by partitions inclosing cells containing each a series of the lamps of different colors, so that separate lamps of different colors can be used to illuminate adjoining portions of the design, without interference of light. A switch apparatus is arranged to throw currents from one to another of the different colored lamps in each series, so that the parts of the design will repeatedly change color in various combinations to which it may be adjusted, and produce effective and attractive exhibitions for advertising, business or decorative purposes.

The automatic commutator switch consists of a roller of non-conducting material, upon which are mounted metal plates. Upon these rests a series of teeth carrying current to their respective lamps in the sign. The roller is revolved by a set of fine gearing and the machines are all made very substantially and will stand constant use for a considerable length of time.

INSULATION.

THE H. W. JOHNS MANUFACTURING CO., of 87 Maiden Lane, this city, have published a very attractive pamphlet, setting forth the claims made for their moulded mica, "Monarch" and "Vulcabeston" insulators. The little book contains 32 pages and is embellished with detail illustrations of railway line apparatus, lamp sockets, cut-outs, field magnet spools, commutator heads and rings, waterproof sheathing, etc.

A WATER POWER AVAILABLE FOR ELECTRICAL PURPOSES.

A COMPANY owning a valuable water power wish to interest capital in an electric plant for light and power. They have a ditch and water right and have at least 5,000 h. p. available. There would appear to be a good field here for a company who will construct a street railroad and a light and power plant. Full information can be obtained of Mr. S. R. Taylor, Logan, Utah.

THE STIRLING WATER TUBE BOILER.

THE accompanying illustration shows the most improved form of the Stirling water tube boiler, about which there has been very title published of a descriptive nature.

The Stirling is the result of experiment, added to years of careful study and individual experience. The aim has been to simplify and strengthen, to render safer and more effective, and at the same time to cheapen the first cost and secure the greatest possible economy of labor and fuel. All details have been carefully calculated and tested in a thoroughly practical manner, and the general construction is claimed to insure safety, economy, efficiency and durability.

The simplicity of construction can readily be appreciated by any engineer, there being three upper drums made of wrought steel throughout, the two forward drums connected with each other below the water line, with a series of tubes the same size as the principal tubes. The steam space of the forward and rear drums is connected to the middle drum by a series of tubes of the same size. The mud drum, also made throughout of wrought steel, is connected to the upper three drums by means of the forward, middle and rear banks of the tubes, as shown in the illustration. Each of the drums where the tubes are inserted, has an extra heavy tube plate, the holes being drilled and carefully reamed to the size required for the tubes. The latter are made entirely of steel and a slight bend is made by a simple machine for rolling the tubes to the proper curve, without undue strain on the material. The tubes before being accepted from the manufacturers, are subjected to a pressure of 2,000 pounds to the square inch, and any tube which shows a leak or any other defect, is condemned.

The boiler is supported independently of the brick work by substantial wrought iron columns and girders. The flanging of the heads of the drums is done entirely with one heating, by means of a powerful hydraulic machine especially devised for this purpose, and on the heads, which contain manholes, the opening is flanged at the same operation. The manhole opening is formed by pressing in a part of the head itself into the shape of the flange, extending entirely around the opening, which of itself forms a reinforcement, and at the same time makes a seat three-fourth of an inch wide for the gasket which is generally used for making a joint with the manhole plate. As this plate is on the inside of the head, the pressure of the steam and water against it, is sufficient to keep it tight, but two manhole bales and bolts are usually furnished to assist in holding the plate against its seat, when there is practically no pressure in the boiler. All the drums before shipment, are subjected to a pressure of 250 pounds per square inch, and made absolutely tight under that pressure.

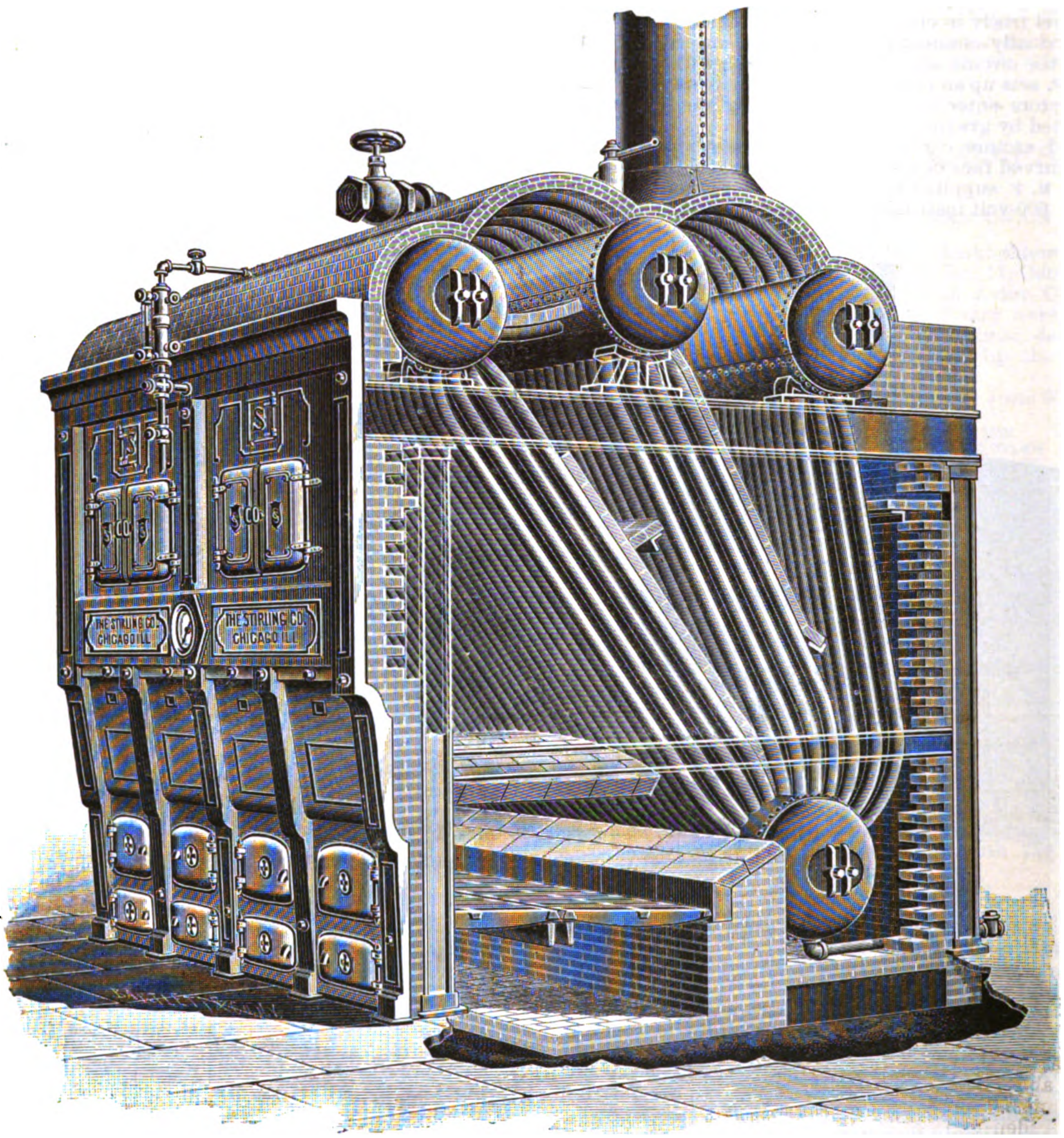


FIG. 1.—THE STIRLING WATER TUBE BOILER.

The Stirling Company claim that their boiler does not contain a pound of cast iron in its construction, even to make reinforcements on the shell of the drums where the outlets for steam, blow-off, feed and safety valve connections are made, wrought steel flanges being used for this purpose throughout. To obtain access to the tubes and drums, it is only necessary to remove one manhole plate on the end of each drum, when the whole boiler is open for inspection. The feed water is fed into a rear upper drum, where the final gases leave the boiler, these gases being usually at not more than 400 to 500 degrees Fahrenheit. If the water has not already attained the boiling temperature, by being passed through the feed water heater, it is gradually raised to this temperature by passing down the rear bank of tubes, to the mud drum, where, if there be any sediment in the water, it is precipitated and can

be blown off once a day. The water is then in a very pure state, and as it circulates up and down the front and second banks of tubes, the circulation is so rapid that whatever small amount of sediment may be retained in the water does not have sufficient time to adhere to the tubes.

Cases are reported where these boilers have not had their tubes cleaned in a year, running night and day, and were found absolutely as clean as when they were put in.

The boiler will, it is claimed, produce steam containing not over .05 per cent. to 1.05 per cent. moisture, which is considered to be exceptionally good for all practical purposes. The small amount of space occupied by this boiler is also noticeable; the usual heating surface per horse power is $11\frac{1}{8}$ square feet, and 600 h. p. in two units of 300 each can be placed in a space not more than 29 feet wide and 16 feet long, and other boilers in proportion.

Fig. 2 shows a plan of the boiler room of the power house of the Thirty-first Street Plant of the Minneapolis Street Railway Co., which contains 1,750 h. p. of Stirling Boilers. This is one of the

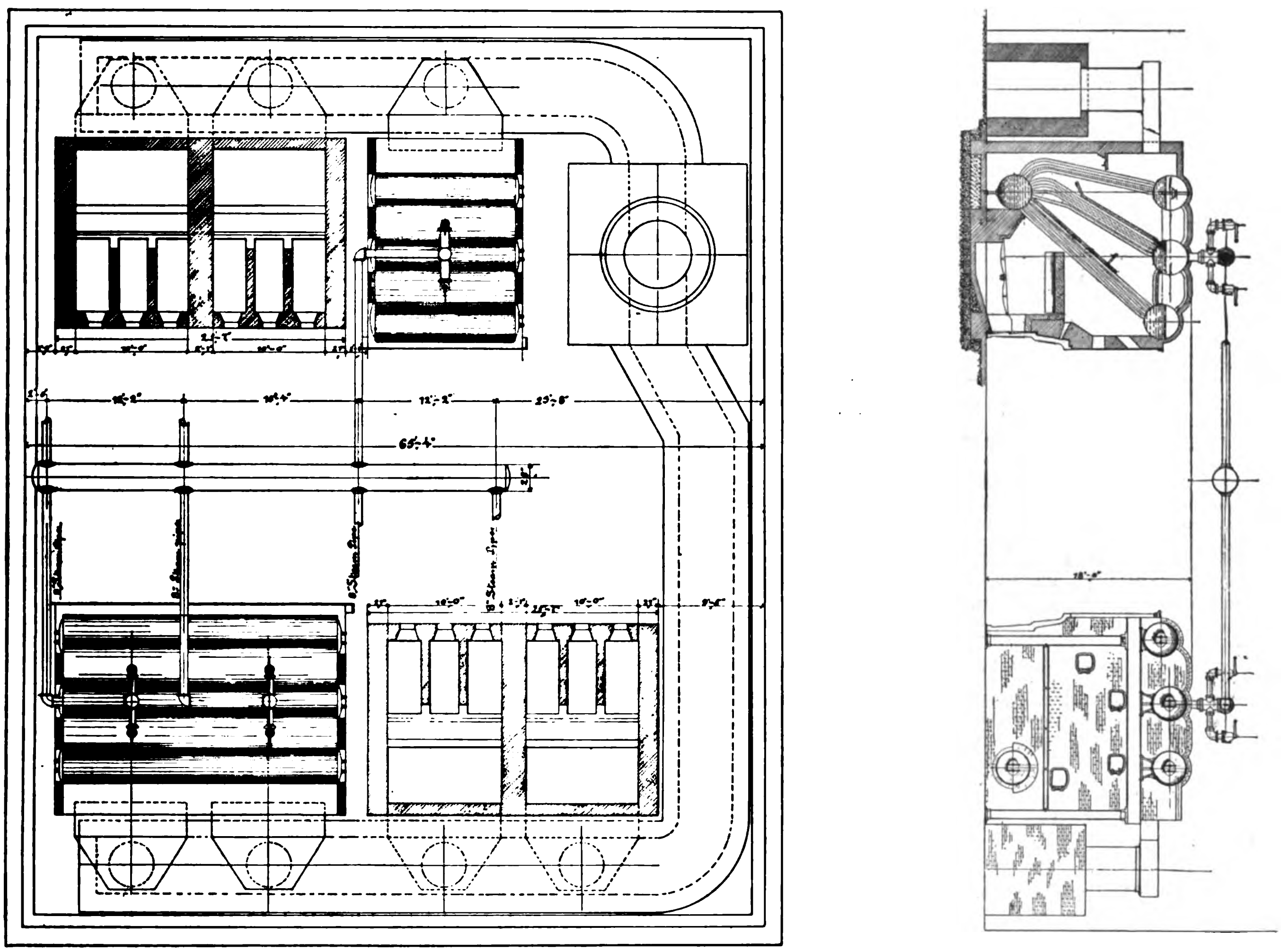


FIG. 2.—1,750 H. P. STIRLING BOILER PLANT, MINNEAPOLIS STREET RAILWAY CO.

stations which was tested by Messrs. Pike & Hugo, the results of which were presented at a meeting of the "American Society of Mechanical Engineers," recently, in Chicago. The boilers at this place have been doing such excellent work that an additional 1,000 h. p. has been put into service.

AN ORDER FOR 400,000 CARBONS.

THE Board of Public Works, of Tacoma, Wash., has awarded the contract for furnishing the city with 400,000 carbons for the arc lights belonging to the city to the Northwest General Electric Company. The only other bid was that presented by the firm of Bradney, Morley & Co., of Tacoma. The amount and kind of carbons bid on were as follows, the bid being that of the Northwest General Electric Company: 100,000 $\frac{7}{16}$ x 12, plain carbons, $9 per thousand; 100,000 $\frac{7}{16}$ x 7, plain carbons, $5; 95,000 ½ x 12, plain carbons, $10; 95,000 ½ x 7, plain carbons, $5.50; 5,000 ½ x 12, coppered carbons, $10; 5,000 ½ x 7 coppered carbons, $5.50 per thousand. The above items aggregate $2,950, carbons being f. o. b. at Fremont, O.

STANLEY TRANSFORMERS AND MOTORS.

THE STANLEY ELECTRIC MFG. CO. of Pittsfield, Mass., have just issued the following important notice:—Owing to the assignment of the Ansonia Electric Co., and pending settlement of their affairs, we have decided for the present to sell our goods direct to users, and for this purpose we have established an office in their building, at 102 Michigan avenue, Chicago, and put same in charge of our Mr. John H. Noble. We are prepared to furnish transformers delivered in Chicago as heretofore, if preferred. We carry a very full stock of transformers of all standard voltages, and orders sent to our Chicago office will receive prompt and intelligent attention.

THE INDEPENDENT ELECTRIC COMPANY.

WHEN the Sperry Electric Mining Machine Company was absorbed by the purchase of its patents on the part of the General Electric Company, the gentlemen owning the largest interests in the concern organized a new company under the above title. This company has continued to maintain its offices and works under the same roof as the Link Belt Machinery Company, at Thirty-ninth street and Stewart avenue, Chicago, and all who have ever visited these admirably arranged shops will concede that they are equipped for the best and most economical work.

Besides the manufacture of its well-known fuse wires the company is prepared to undertake special electrical manufacturing of any kind. Thus among its most recent work is the cloud projector of Mr. L. H. Rogers, recently described in our columns. With its excellent facilities this company is in a position to do justice to the most exacting requirements. The officers of the company are as follows: Arthur D. Dana, president and treasurer; Herbert E. Goodman, secretary and manager; Reuben H. Donnelly, vice-president; Chas. E. Davis, superintendent.

THE LACLEDE CARBON and ELECTRIC CO. are now moving their entire plant for the manufacture of the Hercules and Laclede batteries, insulators, cut-outs, etc., from Peru, Ind., to their new

factory, located at Kokomo, Ind., where they are able to secure an inexhaustible supply of free natural gas for manufacturing purposes. The supply of gas at Peru is rapidly diminishing, necessitating removal. With the new plant and the latest improved machinery they will be even better prepared than ever to serve the public.

HARRISBURG IDE AND IDEAL ENGINES.

THE following are some of the sales made by Messrs. W. R. Fleming & Co. of New York and Boston, representative of the Harrisburg Foundry and Machine Works in Ide and Ideal engines, complete steam plants, etc. One 40 h. p. simple Ideal engine to Messrs. Eimer & Amend, New York City; one 70 h. p. simple Ideal engine for the Metropolitan Museum of Art, New York City; one 25 h. p. simple Ideal engine for the New Bedford Water Works, New Bedford, Mass.; one 50 h. p. simple Ideal engine for the New York Institute of Deaf Mutes; one 50 h. p. simple Ideal engine and Harrisburg high pressure boilers and complete steam plant for the Adams Express Co., New York City; one 100 h. p. simple Ideal engine, Harrisburg high pressure boilers and complete steam plant for Staunton, Va; two 350 h. p. tandem compound condensing Ideal engines, Harrisburg high pressure boilers and complete steam plant for electric railway service for the New Bedford and Fair Haven Traction Co; three 80 h. p. simple Ideal engines, direct connected with ironclad General Electric Co.'s multipolar dynamos for the new Fall River steamer "Priscilla"; two 60 h. p. simple Ideal engines for the Industrial Trust Co., Providence, R. I.; one 25 h. p. simple Ideal engine for the New York Equipment Co.; one 100 h. p. simple Ideal engine for the General Electric Co.; one 50 h. p. simple Ideal engine for the Electrical and Mechanical Engineering and Trading Co.

Messrs. W. R. Fleming & Co. have also several contracts on hand for installation of power transmission machinery with the New York & Pennsylvania Co. for the Langville Black & Carbon Co., New York, and the Hackensack Edison Colonial Electric Company.

SHAWMUT FUSE WIRE.

THE SHAWMUT FUSE WIRE COMPANY, of 161 High street, Boston, have issued a catalogue containing an excellent description of their tested fuse wire and fuse links, and also a treatise on "Fuse Wire and its Use," that cannot fail to be valuable to electricians and architects the world over, whether they employ and specify "Shawmut" or no. The claims of the latter are, however, so conclusively and modestly stated that the reader cannot fail to be impressed. The pamphlet is only 12 pages in length and the subject-matter is concise and to the point.

THE NIAGARA FALLS POWER HOUSE.

THE contract for the Niagara Falls power house has just been awarded. The building will be 200 feet long by 64 feet wide and 40 feet high. All the stone used will be from the Queenston quarry, the roof of iron and slate, the trusses of iron. This present building is only one section, as next year an extension will be added of 400 feet. The ten turbine wheels to be put in will develope 50,000 h. p. The cost of this building is estimated at $100,000.

THE NEW WASHBURN & MOEN INSULATING WORKS.

THE WASHBURN & MOEN MANUFACTURING COMPANY, of Worcester, Mass., have just completed their new wire insulating works which is the largest plant of the kind in the United States. The new building, located at the South Works, at Quinsigamond, is 375 feet long, by 110 feet deep, and has four floors, making an area of 169,000 square feet of floor space. These new works are entirely independent of the company's cable works, which are run day and night on heavy cables and feed wires.

"M. V." AMMETERS AND VOLTMETERS.

QUEEN & Co., INCORPORATED, of Philadelphia, are much gratified by the recent award granted to them for "Magnetic Vane" ammeters and voltmeters for "excellence of design and construction and convenience in use." These instruments are adapted to constant switchboard service, such as is required in central stations and isolated plants. A number of construction companies have adopted them to install with dynamo machinery and the makers will be glad to furnish further particulars to interested parties.

DUPLEX RAIL COMPANY.

THE schedules of the Duplex Street Railway Track Company, of 51 Wall street, New York City, show liabilities of $145,341, nominal assets of $105,250, and actual assets of $1,196. The principal normal assets are contracts which are in litigation, the largest being as follows: Contract with McDonald & Hart to build a street railway at New Orleans, $65,000; contract with the Lake Roland Railway Company at Baltimore, $27,000; contract with Lakeside Street Railway Company at Fort Wayne, Ind., balance, $3,900. No actual value is given to these. The principal creditors are George C Coppell, Trustee, $94,609, for advances; Schoen Manufacturing Company, of Pittsburgh, $24,585, for steel chairs; Lackawanna Iron and Steel Company, of Scranton, $12,496; J. G. White & Co., $10,135; Weir Frog Company, of Cincinnati, $5,225.

NEW ENGLAND NOTES.

THE HAWKS ELECTRIC COMPANY, of Boston, are now quite busy completing the installation of several plants begun during the summer. They are just completing the installation of a plant for the town of Needham, Mass., which consists of 260 25-c. p. incandescent lamps, for street use, and all the necessary poles, hoods and construction work, including 40 miles of line work. The current is supplied by the Elliot Falls Electric Light Company, of South Natick, Mass. It is extremely creditable to Mr. Hawks that when most companies have been almost idle, he has been full of business, and has actually experienced difficulty in getting a sufficient number of good men.

THE W. S. HILL ELECTRIC COMPANY, of Boston, have closed a contract with the Philadelphia Traction Company, of Philadelphia, for 35,000 ampere capacity of switches. The order comprises fifty-two 500-ampere switches, five 1000-ampere switches, and one 4000-ampere double pole double throw switch. It is worthy of note that during the past few exceedingly dull months the Hill Electric Company have been taxed to the full to fill orders, and will this week be compelled to put on a night force to keep up with their orders.

WESTERN NOTES.

J. HOLT GATES, Western Manager of the Waddell-Entz Company, reports the sale of three large direct connected machines to the West Chicago Street Railway Tunnel Company. These dynamos will be direct connected, at a speed of 275 revolutions, to J. H McEwen engines. The Waddell-Entz Company are also installing two large motors, with 200 Waddell-Entz storage batteries, at the Sioux City Swing Bridge, Sioux City, Iowa. Mr. Virgil H. Hewes, engineer of the Waddell-Entz Company, has gone to Omaha to install two 40 k. w. motors, with 400 Waddell-Entz copper and iron storage batteries, for operating the Interstate Swing Bridge at East Omaha, Neb. This plant will be quite novel, from the fact that current will be taken from the street car lines to charge the storage batteries, the batteries of course being in use when the street car service is off.

THE CENTRAL ELECTRIC COMPANY are calling particular attention to the Eichberg patent tree insulator in their new general catalogue. This is a new device intended to overcome the trouble brought about by the destruction of the insulation on line wire, caused from constant rubbing against branches of trees. The insulator perfectly protects the line and gives it plenty of play, when attached to a branch, permitting it to move in any direction with the swaying of the limb. This device is fully described in their new catalogue.

THE ELECTRIC APPLIANCE COMPANY report a number of large sales of their celebrated "O. K." weatherproof line wire. They state that their experience proves that the trade appreciate the superior merits of their weatherproof insulation and of its being sold under a particular brand which insures their receiving a first-class article when the name "O. K." is appended to their orders for weatherproof wire. The time when weatherproof wire orders can be filled with anything having a black cover is rapidly slipping away.

PHILADELPHIA NOTES.

QUEEN & Co., INCORPORATED, Philadelphia, have recently received large additional orders from the Armour Institute of Chicago for instruments to be supplied from their World's Fair Exhibits. This is very gratifying to them, for Prof. Stine is a most critical buyer and insists upon equipping his laboratory with the best apparatus Substantial orders from other large colleges have also resulted in consequence of the Exposition.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. OCTOBER 25, 1893. No. 286.

THE FIELD QUADRUPLEX.

BY

Stephen D. Field

IN a brief note recently published in the ENGINEER, I ventured the assertion that some of the recent "quadruplex improvements" were of questionable value and advanced an opinion as to the location of that most vexatious disturbance known as "The Bug."

To again return to the subject and explain more in detail the opinion advanced, let us examine Fig. 1, which represents the circuit arrangements of the quadruplex for one terminal station, local circuit connections being omitted.

I assume that the line resistance is 3,000 ohms, which necessitates the use of about 300 cells of gravity battery having an approximate internal resistance of 1,000 ohms. It will be seen that an incoming current finds a resistance of 1,000 ohms in its passage to the earth on arriving at the point E, due to the internal resistance of the battery. This resistance causes a division of the arriving current, one-third of which passes through both coils of the differential relays and induces a false charge in the condenser C. If at this moment a change of outgoing polarity is caused by the operation of the pole changer A it will be seen that either the contacts *a b c d* or *e f g h* will be simultaneously in contact, thus placing the point E directly to earth and eliminating the battery resistance for a brief instant. This momentary earth contact is plenty long enough to drain the condenser C of the false charge which it has received from the distant battery. Upon the completion of the stroke of the pole changer the battery resistance is again brought into the circuit and line current rushing into

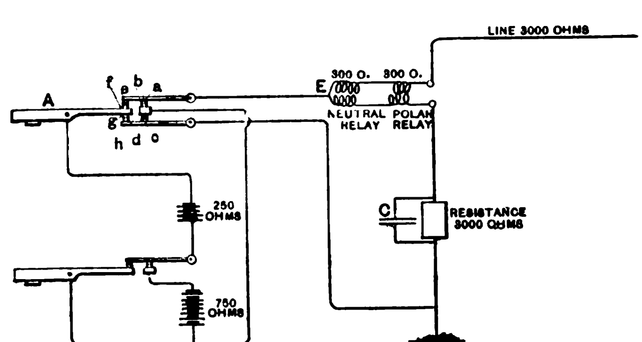


FIG. 1.

the condenser, through all of the relay coils in series, to replace the charge withdrawn while the pole changer was passing its contacts, gives rise to a false signal on the relay armatures and produces—"The Bug." The disturbance is not wholly confined to the home station, for on very short quad circuits it will appear at both ends of the line. It is generally much less at the distant station, as there the disturbing portion of current passes through but one branch of the relays. When full battery power is on the line the disturbance is not noticeable, as the amount of stray current is not enough to overcome the relay bias given by the full battery; but at the moment that the neutral relay is making its excursion to the back stop, just arriving at the stop,

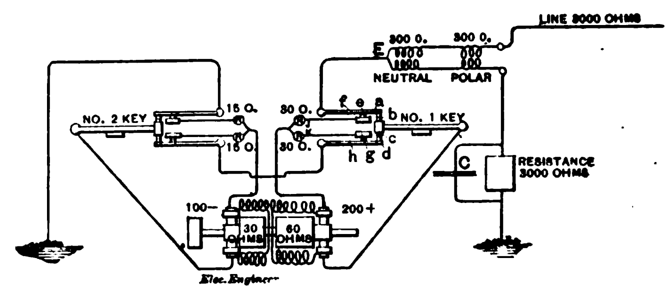


FIG. 2.

or just starting from it, this extra and abnormal condenser charge is quite capable of causing a great disturbance. As its damaging appearance is coincident with the distant reversal, it has been generally assumed to be inseparable from the latter and in fact to be caused by it. That such is not the case can be easily demonstrated by those in position to make the test. Take the standard Western Union battery quad and after obtaining a perfect balance let the distant station cut in a full battery; now turn the adjustment of the neutral relay up to a point where the spring just balances the magnet's attractive force. It will now be found that the balance is no longer perfect and that the neutral relay will respond in a most erratic manner to every movement of the home pole changer.

The balance of any multiplex system should be just as perfect with the battery on the line at the distant station as it is when the line is to earth at that point. Such is not the case with the quadruplex of to-day. In the dynamo quadruplex the same defect exists; here however, instead of the short circuiting of battery resistance by the pole changer, a dead break in the circuit occurs while passing from one polarity to the other. This break serves to increase the charge in the home condenser at the moment of reversal and so produces the greatest disturbance while passing from one contact to the other, instead of at the completion of the stroke as is the case with the battery transmitter.

To overcome the above defects and secure nearly absolute uniformity of action in all positions of the keys, the system shown in Fig. 2, has been designed and operated, its action being all that can be desired and no "Bug" discoverable. The source of current is a miniature multiple shunt dynamo having two shunt and two armature windings. The increase and decrease of current is obtained by reversing a portion of the machine windings. The full current is 300 volts, low potential 100 volts. The keys are so arranged as to be continuity preserving to line but dead make and break in the battery circuit.

Take for instance key No. 1; while making its down stroke contacts *e* and *f* first connect, and simultaneously a

break occurs at *a* and *b*. Now, the arriving current finds low potential armature and earth through the resistances J and K and contact points *e f g h*. A further downward excursion of the transmitter's lever brings *c* and *d* in contact, separating *g* and *h*. The reversal has now been accomplished without any greater circuit disturbance than a brief decrease of battery resistance of from 135 to 105 ohms during the time occupied by the key lever in its excursion. This variation is so trifling as to be inappreciable. There is no danger whatsoever in employing this high potential with low internal resistance provided the dynamo is constructed for the purpose and shunt wound—an accidental short circuit or abnormal lowering of the exterior resistance will be followed by an immediate depolarization of the dynamo and a loss of all current generating capacity. Shunt dynamos of this class do not cause sparking at the key contacts, probably for the reason that the "extra current" of the armature is neutralized by that from the shunt. A further merit is found in the fact that no inductive retardation is presented in the battery circuit to passing signals.

It will be seen that this lowering of battery resistance very materially increases the effective line current due to a given potential. In the present case it results in removing from the circuit nearly 2,000 ohms resistance. In the installation described above, standard Western Union relays were employed which brought to the circuit a resist-

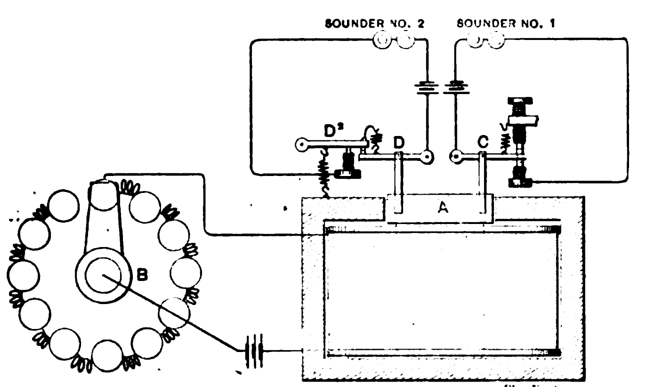


FIG. 3.

ance of about 600 ohms at each station, or 1,200 ohms in the entire circuit. This relay resistance can be very materially reduced by abandoning electromagnets as the receiving medium and in their place using a single differentially wound coil, suspended in a very intense magnetic field as is shown in Fig. 3, which represents a combination relay capable of recording both transmissions by the movement of a single coil, having a resistance of not more than 25 ohms. In the illustration A, represents the differentially wound coil which encircles the pole of a tubular electromagnet, this electromagnet being of a size and wound to such a resistance as to consume about 75 watts or approximately the power required by a standard incandesent lamp. The polarizing current is regulated by means of the rheostat B which in turn is used by the No. 2 receiver as a medium for adjusting the relay to variations in the strength of arriving currents, all retractile springs being fixed and not changeable.

The differential line coil is suspended on opposite sides by four thin springs, two of which are connected on each side to two separate contact levers. The lever C is arranged to record the signals due to current reversals; the lever D the signals due to variations in current strength, and for this purpose is provided with multiple contact points the operation of which is too well known to require description.

Weak reversals simply actuate the lever C and record on the No. 1 sounder. Strong reversals actuate both levers C and D and record on both No. 1 and No. 2 sounders. Variations in current strength of a single polarity cause the lever D to overcome the retractile force of its springs, and by opening and closing its attached contact points record signals on No. 2 sounder alone.

To illustrate some of the advantages to be derived in using this new disposition of apparatus, let us make a comparison between a circuit so equipped and one using the standard Western Union battery quad:

Assuming a line resistance of	3,000 ohms
A battery resistance of	2,000 "
A relay resistance of	1,200 "
We have a total line resistance of	6,200 ohms,

which with an E. M. F. of 300 volts will give us a line current of 0.047 of an ampere. By using the new system on the same circuit we would have:

Line resistance	3,000 ohms
Battery resistance	270 "
Relay resistance	50 "
or a total resistance of	3,320 ohms.

Having the same 300 volts E. M. F. as before, we now have a line current of 0.090 of an ampere, or very nearly twice as much effective line current as in the first case. As 90 milliamperes is largely in excess of any practical requirements for quadruplex work it will be seen that the E. M. F. can be reduced about one-half or brought down to 150 volts and still have the standard working margin. Such a reduction of potential can hardly fail to reduce leakage during rain storms and materially decrease the working strain on buried conductors.

Another feature of merit found in the new apparatus is that the elimination of so much terminal resistance materially reduces the static capacity of the circuit with consequent improvement in its signaling capacity.

In a future article I will endeavor to show how the quadruplex can be further extended and at least four more transmissions added without in any way affecting the operation of the four already accomplished.

THE EMERY PRIMARY BATTERY.

A PRIMARY battery has been devised by Mr. H. C. W. Emery, in which the cells are formed in the shape of a ship's rudder, the elements being suspended vertically from the mouth, which is of small area as compared with the lower part of the cell. The elements consist of zincs and carbons, and when the battery is in its normal position, they are immersed in the electrolyte, which is a solution of chromic acid. In this position the battery is in working order, but when it is required to stop its action it is laid on its front, the cells and the elements thus assuming a horizontal position. The quantity of the depolarizing solution is so regulated that when in this position the elements are high and dry above the solution, which lies in the enlarged part of the cells, and the generation of the current ceases.

HARDENING ALUMINUM.

THE hardness which aluminum is said to lack can, according to a new process, be imparted to it by the addition of chromium. Of course certain precautions have to be taken to alloy the two metals, owing to the difference in their fusing points. If electrolysis is employed for this purpose, one or another of the known methods can be used, and the alumina, salts of alumina, cryolite, etc., treated direct with a determined quantity of granulated chromium or chromium in any other suitable condition, or with the salts or oxides of chromium. Finally, an ingot of chrome-aluminum is obtained, which can subsequently be treated and transformed by known methods. This method, it is said, renders the aluminum as hard as chrome-steel.

WORLD'S FAIR DEPARTMENT.

THE EXHIBIT OF SCHUCKERT & CO.

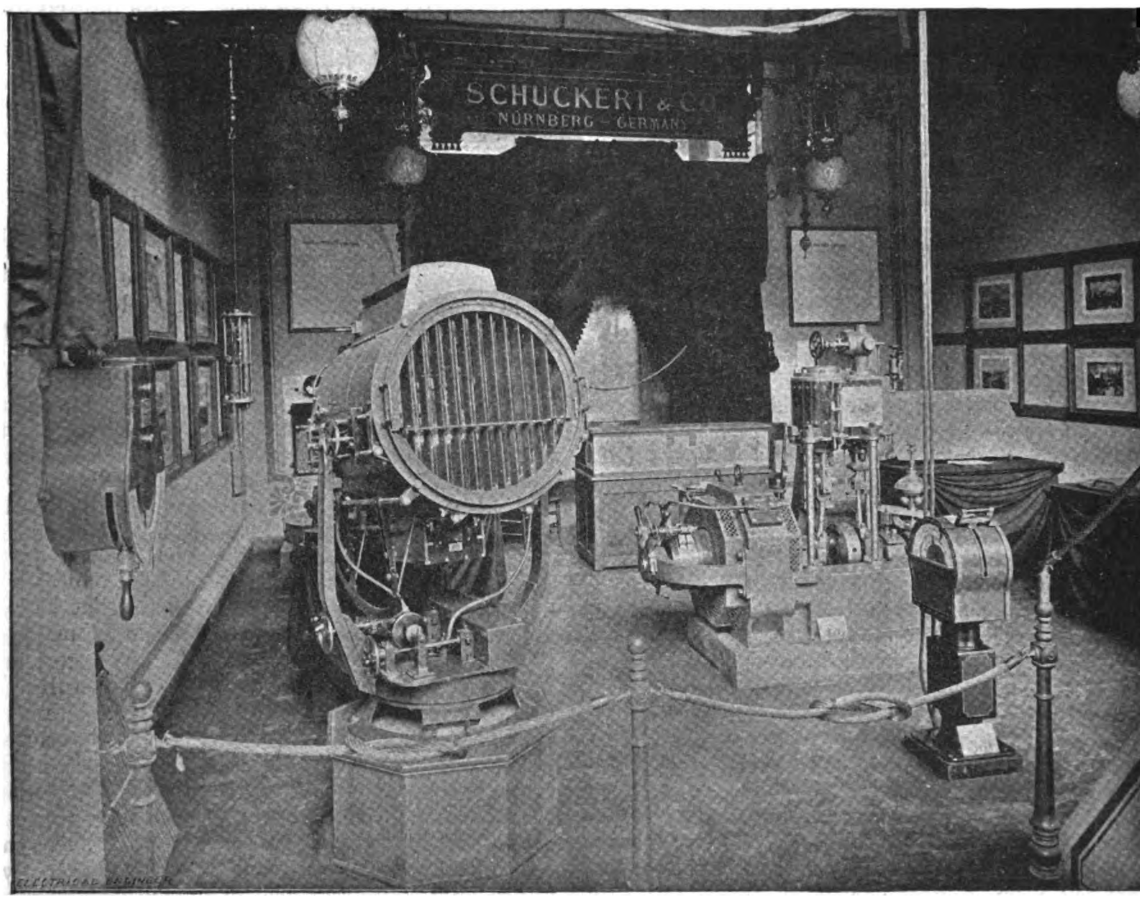
THE exhibit of Schuckert & Co., of Nuremberg, Germany, occupying a section of the German division on the ground floor of Electricity Building, is largely devoted to apparatus for naval purposes. Besides the splendid display of projectors and their accessories there is in actual operation an ingenious device for transmitting signals between the bridge and distant parts of a ship, such as the engine-room, gun turrets, conning tower, etc. It also serves to show the position of the rudder at any moment and the rotary speed of the shaft. One obvious advantage of the system over the purely mechanical ones often used is the elimination of long rods or moving wires and joints for the transmission of the signals.

The transmitter and receiver are united. There is therefore an identical instrument on the bridge and in the engine-room, as the order received has to be returned to furnish assurance that the command has not only been properly given, but also been properly understood

Externally the apparatus resembles the mechanical contrivances commonly used. An easily-moved handle swings round a strong cast-iron case; the momentary position at which it rests showing the order by means of an index on a large and conspicuous dial. The command received is also electrically indicated upon the dial of the apparatus in the engine room.

The process and the arrangement are as follows: A number of contact-pieces, each one of which corresponds to an order, are disposed in a circular or semi-circular frame. From each of these contact-pieces, a wire leads to the receiver which consists essentially of a Gramme ring, containing a double T-shaped armature. The ring, with windings closed on themselves, presents as many sections for receiving a current as it has conducting wires. If now two contact-pieces, one over the other, are excited, the current will be led to, or from, two corresponding and juxtaposed plates of the armature. At these places magnetic poles are then formed which attract and fix the double T-armature in position. The advantage of this disposition is that all the coils are always traversed by the current, and that, in this manner, a powerful effect is produced, while the current consumed is comparatively insignificant. The apparatus admits of many modifications and has been built both as a helm-control indicator and a speed indicator.

Other striking features of the exhibit are three search lights of different sizes and styles, according to the purpose for which they are intended. On an elevated platform, seven feet high, is a search light of the standard form adopted by the German navy, as applied on the man-of-war *Kaiserin Augusta*, which took part in the naval parade in New York last spring. Schuckert search lights, it will be remembered, have parabolic glass mirrors—those



SCHUCKERT & CO.'S EXHIBIT IN ELECTRICITY BUILDING.

shown being ninety centimetres in diameter—and a horizontal arc lamp arranged to regulate the focus automatically as well as by hand. They are further provided with a double set of dispersion lenses, one of which is so arranged that it can be moved to or from the other, according to the amount of dispersion required, between the limits of two and forty-eight degrees, by a hand wheel. The apparatus is controlled by two electric motors, one connected with a governor, by means of which it may be operated from a distance. On board ship the governor is placed on the bridge and consists of an exceedingly simple switching device with only one handle, so that the commanding officer may have his other hand free. The light may also be revolved by hand and the apparatus is provided with a device for flash signaling. This searchlight is in operation at the exhibit every night, showing the various uses to which it may be put. The energy consumed in the arc is one hundred amperes at fifty-five volts.

Another naval search light is shown with a mirror sixty centimetres in diameter and in all other respects similar to the one described. Near this stands another projector sixty centimetres in diameter, arranged for shore fortifications. As the position of the base in a stationary instrument is always fixed, the projector is provided with a sight, and vertical and horizontal rings graduated in degrees. By this arrangement any desired point may be found by day and the amount of rotation and elevation noted, so that at any moment at night a beam may be thrown upon it instantly, without the necessity of a previous search. This instrument is also provided with a single plane glass and separate dispersion lenses which may be interchanged by hand. The next apparatus to strike the eye is an engine dynamo for marine purposes, adopted by the German Navy. This is a multipolar machine, extremely solid and simple in construction, and has a Gramme armature with coils of equal potential and polarity connected in parallel, so that only two sets of brushes are necessary, and these have a very simple arrangement for adjustment.

Among the other exhibits may be mentioned a number of measuring instruments, recording wattmeters and voltammeters for station work, widely used in Europe on account of their accuracy and simplicity. The space is lighted by Pilsen arc lamps, manufactured by Messrs. Schuckert & Co. These have a simple, differential regulator and burn steadily with an agreeable light; they are also extremely artistic in appearance. A small collection of carbon pencils, exhibited by C. H. Schmelzer, of Nuremburg, is also shown.

Another striking exhibit is a plate of electrically deposited zinc, four feet long by two feet wide, obtained from the works of Gewerkschaft Siegena in Grevenbrueck and Gewerkschaft Silicia in Meggen, both in Westphalia, by the process of Dieffenbach-Kittler. By this process the metallic zinc is obtained directly from the ore. On the walls of the space are a number of drawings demonstrating the optical principles of the Mangin spherical, and the Schuckert parabolic, mirror, intended to show the superiority of the latter. Besides these, several photographs give one an idea of the Schuckert factories and workshops in Nuremburg, as well as a number of central stations using their apparatus. In the Nuremburg works are employed about 2,000 workmen, who turn out yearly an average of one thousand dynamos, ten thousand arc lamps, three thousand measuring instruments and over one hundred search lights.

The company have a number of additional exhibits throughout the different buildings of the exhibition. Upon the highest point of the Manufactures and Liberal Arts Building four Schuckert search lights, one at each corner, are in operation every night, from 7 to 9 o'clock. The following table shows, at a glance their respective sizes, candle powers and ranges:

Corner.	Diameter of Projector or Parabolic Glass Mirror.	Consume.		Intensity of Light sent out by the Parabolic Glass Mirror.	Beam of Light visible at a distance.
		Amp.	Volt.		
N. W.	60 inch.	150	60	194,000,000 c. p.	100 miles.
S. W.	44 "	140	58	104,300,000 "	60 "
S. E.	36 "	90	52	66,000,000 "	40 "
N. E.	24 "	50	46	29,400,000 "	25 "

In Machinery Hall there is an Otto gas engine directly coupled with a Schuckert dynamo in operation, supplying six arc lamps and six incandescent lamps with current, and designed to show the arrangement of a small isolated plant for residences and moderate sized buildings. In the south gallery of the Transportation Building, are eight beautifully executed drawings of some of the central stations built and equipped by the same company. The German Government Building, on the Lake shore is also lighted by Schuckert & Co.

It will be seen that the entire exhibit of the apparatus of this firm, being confined to no particular building and to no one branch of work, furnishes an excellent idea of their great facilities and the excellence of their workmanship throughout an extremely wide field.

THE NATIONAL CARBON CO.'S EXHIBIT.

The exhibit of carbons at the Philadelphia Electrical Exhibition of 1884 was small, but interesting, while that of 1893 at Chicago is not much larger, in spite of the rapid strides made by the arc lighting industry. This is due to various causes and reasons, and it is worth while to note that this branch of the art has remained pretty much in pioneer hands,—a good evidence of ability to hold the trade by steady improvement in product with a not less remarkable ability to reduce prices from the wonderful maximum that prevailed a dozen years ago. The display of the National Carbon Co. in Electricity Building is highly creditable to this time-honored concern, and is so well selected and arranged that it attracts attention as well by its beauty as by its intrinsic merit. One sees curious artistic abortions at the World's Fair, such as that of a gallant horseman and steed built up of prunes but where taste and judgment have been exercised as in the National Carbon exhibit, the results are most gratifying. The central part of the exhibit, which stands in the gallery, is a pavilion, whose columns are skilfully composed of carbons and corrugated carbon plates. The carbon rods are 1½ inches in diameter, and of beautiful grain and finish. The tops or capitals of the columns are carbon discs separated by coppered carbon brushes. Over this is stretched a canopy draped in the national colors. Beneath the awning in the central space is a pyramid of carbon goods of various shapes and sizes, while around, on each face, at the foot, are grouped other varieties, including the massive electrodes employed in electro-metallurgy. This central piece is flanked by a number of members of smaller size. We are also treated to a clever reproduction of feudal architecture in carbons, presumably to typify the fortunes and baronial splendor of the arc light magnates of the earlier times, before the effort was made to erect an absolute monarchy on the ruins of a score of "systems," and "fundamental" patents.

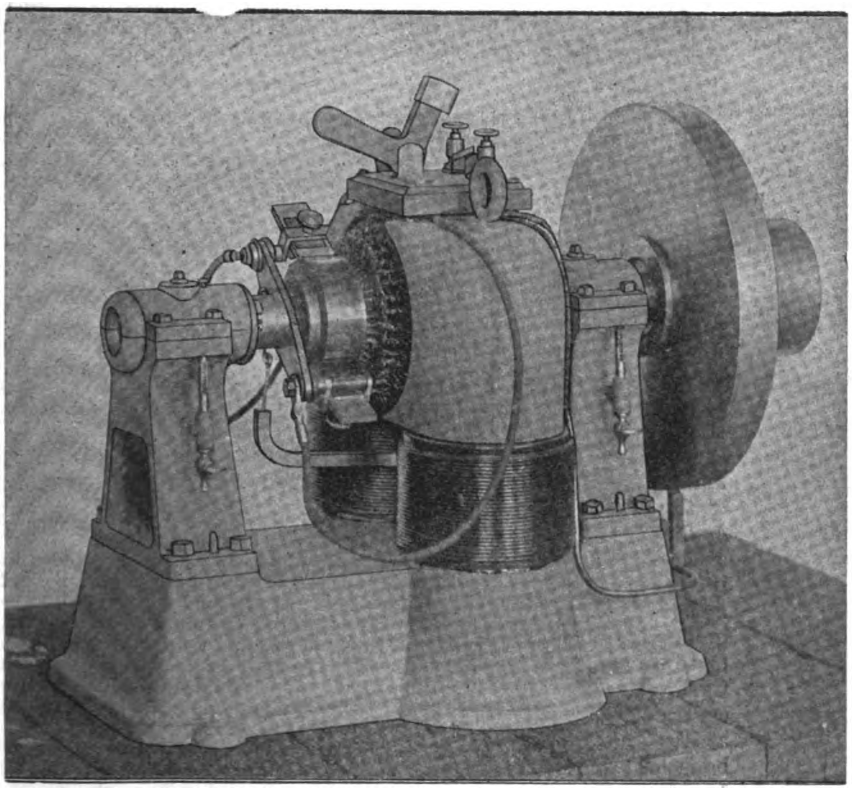
No exhibit at Chicago is complete unless it includes the biggest of big things in its own peculiar province. "Give me bigness or give me death" is the slogan of Western supremacy, and hence the World's Fair is an aggregation of big things. The National Carbon Co., although hailing from east of Chicago, has in nowise been outdone in this direction of endeavor, but back and front of its display has two tiny carbon electrodes 24 inches long and three inches in diameter. They look like cores

out of a coal bed that had been sampled with a cheese taster. They are supported by two others not quite so large but finely electroplated.

We are all familiar nowadays with the changes rung upon carbon in batteries, with the object of obtaining the greatest amount of surface, etc., and there are many instructive forms scattered around this exhibit. But one may be forgiven if somewhat impressed with the importance attained by the carbon brush, whose place in the art is here very impressively shown. Cleveland has doubtless many effective displays of her electrical industries in Electricity Building, but this assuredly is not the least.

KEITH MOTORS AT THE FAIR—ELECTRIC POWER DISTRIBUTION BY CONSTANT CURRENT.

THE discussion in Section "C" of the late Electrical Congress upon electric power transmission and distribution



THE KEITH CONSTANT CURRENT MOTOR.

brought the following facts forcibly to the attention of electrical engineers :

1. That extensive electric power transmission over distances up to 20 miles, by direct currents, is thoroughly practicable, and in commercial use in many places.[1]

2. That polyphase systems of electric power transmission are still considered by some to be in the theoretical stage, from which they may emerge into practice.[2]

3. That direct current dynamos of high potential and high quantity are not impracticable for construction and operation.[3]

There are two systems of direct current electric transmission; the constant potential, and the constant current, both of which are in practical use. They both have the same conditions of insulation. But the constant potential system, according to some, labors under a disadvantage, viz., the difficulty of stopping motors of high potential by breaking the circuit to them ; witness, for instance, the switching apparatus employed by Deprez in his Creil experiments for preventing flashing at the switches, 6,000 volts being used.

In the case of constant current transmission with varying potential, this condition does not prevail. The potential is automatically lowered to the minimum, and at the motor, and in the act of stopping, and rises in the same way in the act of starting.

To effect these *desiderata* it is necessary to provide the generator with an automatically acting regulator of potential which will vary its potential in exact proportion to variations in the work on the circuit, and keep the intensity of the current the same under all conditions. It is also necessary to use motors which in each case automatically change their potential in exact proportion to the variations in the work done by them.

We illustrate one of this class of motors, which are in extensive use in many places on the Pacific Coast, notably in San Francisco, and which are made under the system invented by Dr. N. S. Keith. Several of these motors are operated at the Columbian Exposition in Electricity Building. The motor is governed by moving the brushes circumferentially on the commutator, by the action of the torque of the pulley on the belt, in response to the amount of pull which is necessary to move the belt at constant speed under all variations of work imposed upon the motor within its capacity. It is a dynamometric governor, which acts to place the brushes on the commutator at the points which cause the motor to exert a torque just sufficient to accomplish its work, and before there is any change in speed. The generator is likewise governed by moving the brushes circumferentially on the commutator. But they are moved by electromagnetic appliances so as to keep the current constant and vary the potential as requisite.

It is ordinarily understood to be impracticable to move brushes upon commutators of generators of high efficiency, other than on arc light dynamos, on account of excessive sparking, and consequent damage to commutators, as well as other ills. The same is the case with motors. But, by reason of a peculiar winding of the armatures of generators and motors, devised by Dr. Keith, this injurious sparking is altogether avoided. The motors are placed in series on the circuit, like arc lamps. The potential of the generator may be as high, at least, as that of arc-light dynamos (say, 5,000 volts), and the amperage may be as great as desired ; the only requisite being to properly proportion the commutator and brushes.

Where a motor of considerable size is to be stopped the brushes are slowly moved to the point of minimum potential and then by a switch the motor is short-circuited.

Dr. Keith is about to introduce in the East, this system which has been eminently successful in the far West.

1. S. P. Thompson, THE ELECTRICAL ENGINEER, Sept. 20, 1893, p. 269. Dr. N. S. Keith, THE ELECTRICAL ENGINEER, Sept. 6, 1893, p. 228.

2. Prof. S. P. Thompson, THE ELECTRICAL ENGINEER, Sept. 20, 1893, p. 269. Dr. N. S. Keith, THE ELECTRICAL ENGINEER, Oct. 4, 1893, p. 305.

3. Prof. F. B. Crocker, THE ELECTRICAL ENGINEER, Sept. 6, 1893, p. 227, and Dr. N. S. Keith, THE ELECTRICAL ENGINEER, Sept. 6, 1893, p. 228.

THE ELEKTRON ELEVATOR.

SOME weeks ago we illustrated and described the elevator exhibit in Electricity Building of the Elektron Manufacturing Company, of Springfield, Mass. This elevator communicates with the galleries, and has proved extremely useful and serviceable to exhibitors and to the public, which at this show, contrary to all wont and precedent, is little inclined to take its pleasures "up among the Gods." Last month—September, the elevator carried no fewer than 49,742 passengers, and this month it bids fair to beat even that record.

ADDITIONAL AWARDS IN THE DEPARTMENT OF ELECTRICITY.

UNITED STATES.

Brush Electric Co.; Historical Exhibit; Carbons for arc lamps.
Graves Arc Lamp Co.; Arc lamps.
N. S. Keith; Constant current motors.
The Mather Electric Co.; Automatic adjustable circuit breakers.
National Engraving Machine Co.; Jewelers' engraving machine.
The Standard Paint Co.; Insulating compound, liquid.
S. S. White Dental Co.; Application of electricity as a motive power for electric drills.
Westinghouse Electric and Mfg. Co.; Electric meter, "Shallenberger;" Constant potential, alternating current arc lamps; System of arc lighting by alternating current.
General Electric Co.; Thomson lightning arrester.

ENGLAND.

General Electric Co., Ltd.; Carbons.

JAPAN.

Eizaomon Tukagawa Saga; China insulator.

ITALY.

Societa Ceramina Richard, Milan; Insulators.

GERMANY.

Siemens & Halske; Cored carbons.
Schuckert & Co.; Registering watt meters; Station ammeters and voltmeters.
Von Poppenberg, Charlottenburg; Dry batteries.

RUSSIA.

N. Wladimiroff; Portable storage battery.

AWARDS TO QUEEN & COMPANY.

QUEEN & Co., INCORPORATED, Philadelphia, who loaned a number of standard instruments to the World's Fair Committee of Judges, for use in making tests have received a courteous acknowledgment from Secretary Anderson. Two additional awards have been granted to Queen & Co., making seven in all received so far, and they are hoping for several more.

SELLING WORLD'S FAIR EXHIBITS.

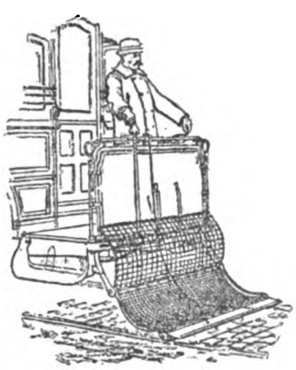
THE BRUSH ELECTRIC COMPANY has been singularly fortunate in selling its World's Fair exhibits, and Mr. S. M. Hamill informs me that he has an idea the Company may start a new department in the factory to make World's Fair plants and souvenirs. Be this as it may, the company has done remarkably well here with its apparatus, and continues to close new contracts. Mr. Hamill states that he has just sold two 65 lighters and 100 arc lamps to the Rock Island Electric Light Company, Rock Island, Ill., to be installed as soon as possible.

The beautiful temple in the centre of the Brush exhibit is the rendezvous of a great many old time Brush local company officers, from all parts of the country. Within the last few days, it has welcomed such men as George Roe, of San Francisco; C. R. Huntley of Buffalo, and Fred. Gilbert of Boston.

MR. RUDOLF EICKEMEYER, JR., has been a constant attendant recently in Electricity Building, with his cousin Mr. Adolph Kroeber, Jr., graduate of the Technische Hochschule of München, Bavaria, and son of Adolf Kroeber, a member of the German Parliament.

ELECTRIC RAILWAY DEPARTMENT.

THE WORCESTER STREET CAR FENDER.[1]



THE accompanying illustration shows the Worcester fender and shield, invented by Mr. T. C. Rice, is in use on the Worcester and Shrewsbury Railway.

The shield is made of hand-wrought, heavy steel spring-wire netting of two-inch mesh, and is supplemented by a strip of flat spring steel running the length of the shield, and back of this and attached to it is a half elliptic spring bending inward and bearing against the car front. The shield is a provision for taking up the concussion as a body, tripped by the fender, is thrown upon it.

The fender is constructed of wire netting curved downward from the front and upward to the rear to form a cradle, and its rear is supported by a loose ring attachment to a shaft pivotted at each end to iron hangers, which are bolted to and under the ends of the car side, while its front is swung by means of loose rings to a half-inch rod running between and rigidly secured to the lower and forward end of two arms, bent to correspond to the form of the cradle, with their two upper or rear ends pivotted, with the hangers, to the shaft above-named at a point 15 inches above the rail, while the half-inch and to which is swung the front of the cradle is 3½ inches above the road rail, and as the wire cradle is depressed from the half-inch rod rearward, the rod forms a shoulder which effectually prevents sliding or falling forward and off the fender.

Beneath, and an inch or more forward of the half-inch rod, is a three-quarter-inch shaft, shouldered at the ends and at these points piercing the lower ends of the curved arms and fastened rigidly by nuts. Upon this shaft are four loose three-inch rollers, two to ride the rails and two intermediate. Still forward of the shaft and one inch higher the arms are again pierced, and there is pivotted the share, which is a sheet metal plate, five inches wide and faced with three-inch rubber belting, one-fourth inch thick and projecting beyond the metal sheet two inches. This share—of metal and rubber seven inches wide—is pivotted, but provided with sets so that it may be fixed at any angle.

Ordinarily the front edge of the share is set at three quarters of an inch above the rail and the upward inclination is nearly in line with the half-inch rod.

The fender folds back against the dash and shield for a rear end, while the shield is dropped into the cradle for coupling cars.

1. Providence *Journal*.

DIRECT-DRIVEN GENERATORS.[1]

BY C. J. FIELD.

MANUFACTURERS of both engines and generators were applied to for information relative to this subject and a summary of their replies has been made in the preparation of the report. The paper begins with a brief history of the introduction of direct driven generators both in Europe and in this country, after which the different important types at present in use are taken up and described. These mentioned are the Westinghouse generator with a Westinghouse engine and flexible clutch coupling; the power generator of the Siemens & Halske company with the armature mounted directly on the engine shaft; the generator of the old Edison company connected with an automatic cut-off marine engine; one of the large Intramural units at the World's Fair consisting of a General Electric generator of 800 kilowatts coupled to a vertical compound marine Lake Erie engine; and another by the General Electric Company of the class used in the Brooklyn City Railroad. One of these last is also in operation in the Intramural power house coupled to a Reynolds-Corliss engine.

The best type of engine to use is then discussed, preference being given to the vertical marine type. An engine of this class, well and substantially built with double valves on the steam and exhaust, and controlled by shaft governor, controlling the valve up to three quarters cut-off, would seem to combine many points of superiority of an engine on this class of work, and give service in reliability, economy and durability, superior to any other type obtainable.

In regard to the relative advantages, cost and economy, the author states that though the direct driven units sell for about 20 per cent. above the belted machines, yet the cost of the station complete, exclusive of real estate, but including the same electric plant and building, is not more on a direct driven plant than with the older type of belted apparatus, and that many railroads will find it to their advantage to scrap and sell at the best advantage they can their present apparatus, and build a new and modern station. The economy gain will be a large one in every respect; more reliable service; satisfaction to the public; reliance in the operation of their car service, which they have never been able to realize with their old type of small belted generators, and a reduction in station force. An instance is cited of a power plant of about

1. Abstract of a Report submitted at the meeting of the American Street Railway Association, Milwaukee, Oct. 18, 1893.

5,000 h. p., where the company after a careful review of the case have become convinced that they could build a new power plant and scrap their present apparatus; increase their fixed charges thereby $15,000 a year, and still have a net gain over their increased charges of $25,000 per annum, and in addition to this a far more reliable and better operating plant and increased capacity.

The author believes that we have now reached what may be termed a point of standard commercial perfection on generators for power service of all descriptions, and that the next ten years will see very little change other than the perfection of minor details thereon, and instead of having a station operating from twenty to forty varying types and kinds of small generators, we will have a compact and modern plant of a few large units.

POWER HOUSE ENGINES.[1]

BY E. G. CONNETTE, CHAIRMAN.

THE subject of Power House Engines for Electric Railways embraces one of the most important and interesting subjects that street railway companies have to consider in the equipment of a power plant.

The most essential points to be considered are: 1. Perfect Regulation; 2. Highest Economy; 3. Greatest Durability; 4. Division of Power into Units.

PERFECT REGULATION.

Good service and uniform speed of cars can only be maintained by a constant, unvarying potential, and in order to do this the engine must regulate practically perfect, so that there will be no variation of speed as the load varies. On an electric railway this variation of load amounts to a very considerable fraction of the whole maximum load; in small plants it may read 95 per cent. of the maximum, and in large plants is frequently 50 per. cent. The governor should be so constructed as to control the engine under any variation of load, with a variation of speed not to exceed two per cent.; be easy of access to all of its parts, and capable of being oiled while the engine is running. The range of cut-off must also be larger than in engines for less variable load. This cut-off should be easily regulated between the limits of $\frac{1}{10}$ and $\frac{7}{10}$ of the stroke.

The severe conditions of high speed, and sudden and extreme variations of load, make it especially important that the engine have the best possible construction, with extra weight in the fly-wheel and bed-plate, and that the foundation be more than usually substantial, and also that the engine be placed in the hands of a competent engineer, who is capable of adjusting and keeping the engine in good running order.

HIGHEST ECONOMY.

In order to obtain the highest economy in the operation of an engine, it is necessary to have the engine properly adjusted to its load. Underloading or overloading are each, undesirable, though the compound condensing engines of the largest stations will stand underloading better than the simple high-speed engine, and both classes of engines will stand underloading better than overloading; there should then be ample power both in boilers and engines to obviate excessive overloading as well as to provide for contingent breakdowns or needed repairs. Whatever the style or type of engine adopted, it should be kept scrupulously in the best possible working condition. Careful attention should be given to the setting of the valves so that the cut-off will be the same at both ends of the cylinder. The engines should be set in the closest proximity to the boiler so as to require the least amount of steam pipe which should be covered with one of the best non-conducting materials. Flexible joints should be used to prevent leaks at the joints from expansion and contraction.

We are so accustomed to consider the reciprocating engine as the only steam motor within our reach that it is not surprising that a new form of steam motor should have quietly been developed without our notice. The committee refers to the steam turbine, one form of which, the Parsons' steam turbine, has recently been subjected to vigorous and searching trials and tests by Prof. A. B. Kennedy, of London, England, who has developed power at the rate of $20\frac{7}{10}$ pounds of water per electrical horse-power per hour in a turbine using steam at 97 pounds per square inch, and making 4,600 revolutions per minute, the turbine having a capacity of 165 h. p. This is a strong rival to the reciprocating engine as a steam motor for electric power and light stations.

The boiler plant should have ample capacity as there are few cases when the draft and setting are so excellent as to allow heavy forcing without a serious loss of economy. The boilers should be equipped with good boiler cleaners, and should be inspected regularly and kept free of scale; the flues should be kept clean and boiler walls intact; with the boilers in proper condition, and with proper draft, the very best results should be obtained, but in order to do this the boiler room must be in charge of a competent man.

Fuel is one of the largest items of expense attached to a power-house, and the waste of fuel by incompetent firemen is one of the greatest leaks attached to the operating expenses. A good plan to encourage economy on the part of the firemen is to pay him a coal premium at the end of each month, basing the amount of the premium paid on the average number of bushels of coal consumed each day during the month for a certain number of cars run. When the plant is of such size as to require more than two firemen, it will always be good economy to employ mechanical stokers; aside from this saving in labor account, they economize fuel, insure uniformity of steaming, prevent the chilling and straining of crown sheets by in-rushes of coal air, through the fire doors, and prevent smoke; that is, if properly chosen, constructed and operated.

The use of oil as fuel in place of coal is a live question with power and light station engineers and managers. Actual trial of oil, keeping accurate records of costs and results, will be the only absolute answer to the important question, "*Does it pay?*" But as an oil installation is somewhat costly as an experiment, it is best to secure as full outside evidence as possible on the question as to the *probable* economy. Fortunately, several accurate comparisons have been made with sufficient care and accuracy to make them valuable witnesses. Probably the most complete evidence of this kind comes from a recent and exhaustive test of the power plant of the Twin City Rapid Transit Company of Minneapolis and St. Paul. Minnesota, made by Messrs. Wm. A. Pike, of Minneapolis, and T. W. Hugo, of Duluth, Wisconsin.[2] On the comparative value of the two fuels, coal and oil, this test showed that with the ordinary Lima oil weighing $6\frac{6}{10}$ pounds per gallon, and costing $2\frac{1}{4}$ cents per gallon, and coal that gave an evaporation of $7\frac{1}{2}$ pounds of water per pound of coal, the two fuels were equally economical when the price of coal was $3.85 per ton of 2,000 pounds. With the same coal at $2 per ton, the coal was 37 per cent. more economical, and with the coal at $4.85 per ton, the coal was 20 per cent. more expensive than the oil. These results include the difference in the cost of handling the coal, ashes and oil. The oil used gave the following as the result of the average of five chemical analyses: Hydrogen, 13.08 per cent. Carbon, 18.88 per cent. Evaporation, 20.68 pounds water from and at 123° Fahr. per pound of oil.

The obvious and intelligent way to get the most work out of a steam plant at the least expenditure, is to ascertain first how the total expenditure chargeable to power per unit of production compares with other street railroads. To do this it will be necessary to furnish the station engineer with full facilities for testing and maintaining records of each part of the station plant and operation. The standard of maximum efficiency attainable should be ascertained with each portion of the plant, and each part brought up to that standard. With modern appliances and fairly well constructed plants a total station efficiency of 70 per cent. should be set as the standard.

The loss of power between the engine and switchboard terminals is from 15 to 25 per cent., which is attributable to the inefficiency of dynamos, and also to the friction of countershafts, belts, idlers and attachments. This waste of power can be overcome by connecting the generator direct to the shaft of the engine.

The Committee look with favor upon compound engines for street railway work, especially so with engines having ranges of cut off wide enough to keep tha low pressure cylinders ever from expanding below atmosphere. When this is the case, there is no doubt that the compound engine is very economical as it carries the expansion of steam to a greater limit. Where it is possible to condense in connection with the compound engine, there is not the slightest question as to economy. In fact where condensing is possible, there is no reason why the expansion should not be carried to a further limit.

The practice occasionally followed of placing the generators in the second story of the power house is not to be recommended, even where floor space is difficult to secure. The difficulty of securing for the dynamos rigid foundations, and the resulting evils of increased frictional losses and heating, will generally render this disposal of plant inferior to placing the dynamos on rigid ground foundations.

GREATEST DURABILITY.

When electric traction was first introduced for street railways, engine builders were not cognizant of the actual requirements for this kind of service; they did not anticipate fully the extraordinary variation of load and the liability of a short circuit, which so severely tests the strength of the engine. They proceeded to build engines from theoretical plans and specifications which have proved by actual practice to be entirely inadequate for this class of work. Engine builders, however, are endeavoring to overcome mistakes which were made at the outset by strengthening and making all of the parts more

1. Abstract of a Report submitted to the American Street Railway Association, Milwaukee, Oct. 18, 1893.

2. See THE ELECTRICAL ENGINEER, Aug. 9, 1893.

durable and to make such improvements as will meet all the demands for this extraordinary class of work.

DIVISION OF POWER INTO UNITS.

Local surroundings and conditions will, to some extent, govern the division of power into units, but, as a rule, the following principle will be safe to follow: The size of the proper unit of subdivision should be such as to give the required relay or reserve above the maximum power adopted. This will apply equally to boilers, engines and dynamos. The following table will serve to show approximately the proper proportion:

Maximum h. p. required to operate road.	Number of engines required.	H. P. of each engine.
200	2	200
400	3	200
600	3	300
1,000	3	500
1,500	4	500
2,000	4	750

It will be observed from the above table that enough engines are provided to furnish the maximum horse power required to operate a road and have a surplus of one engine. This is very essential, as it enables the engineer to keep his engines in perfect adjustment and repair, having at all times an extra engine to work on, or, in case of breakdown, the extra engine is ready to to take the place of the disabled one. The "*Maximum horse power required to operate the road*," referred to in this table, is not to be taken as the sum of the power needed by each car in service, except in case of small installations, since the maximum power required does not increase in proportion to the number of cars in use, since the line losses are not materially increased with increased traffic, and because, as the number of cars increases, the fluctuations of load tend to balance themselves and to reduce the *maximum* load nearer to the *average* load. Thus in a 10-car plant, cases will occasionally occur when all of the cars will require their full power at the same time, and the power plant must be planned accordingly, but there is no probability that all of the cars of a 100-car plant will all require their full power at the same time; from 60 to 75 per cent. of this power, depending upon local conditions, will be sufficient for this plant.

In selecting a type of engine, the size of the installation must largely govern, as well as local conditions, such as water supply and price of fuel, though some consideration may be given to opportunities for station-room and arrangement. For small plants to run ten or fifteen cars, simple high speed engines, belted direct to generators, are unquestionably the proper choice. For twenty to fifty car plants, compound engines, with condensing apparatus where it is possible; with tandem compound engines for the smaller plants and cross-compound engines for the larger ones, geared direct to generator, will probably be found most economical. While for the larger systems compound or triple expansion condensing engines, using steam at a high initial pressure and either driving a countershaft or coupled direct to generator, whichever the conditions of the case will warrant, will be found a proper selection. In every case, except for small plants, where engines are belted direct to generator, the vertical type of engine is recommended.

In conclusion, the Committee desire to impress the importance of keeping the steam plant as near as possible to the conditions that exist when the engines are installed and being run under the supervision of the mechanical engineer who installed the plant. This, perhaps, is of as much, or more, economic importance as the design of the engine, as the plant is then run by the expert in charge with a view to attaining the highest degree of efficiency and economy.

THE USE OF STORAGE BATTERIES IN ELECTRIC GENERATING STATIONS FOR UTILIZING AND REGULATING POWER.—I.[1]

BY C. O. MAILLOUX.

IN Europe the use of storage batteries in central stations has unquestionably made great progress during the last three years, and has actually succeeded in commanding the respect, if not in entirely overcoming the scepticism, of electrical engineers generally. The irregularities of load, on power circuits, especially for electric traction purposes, are the bane of the electric railway engineer; and they are too well known and understood to require further mention now, except to classify them; for, in reality there are two kinds, which must be carefully distinguished from each other, almost as if they constituted distinct diseases, so to speak, requiring different treatment, even though they may appear together in the same case. We must, therefore, distinguish between "variations" and "fluctuations" of load. The author uses the term *variation* to designate the effect caused on the station plant by putting on or taking off a certain number of cars; and the term *fluctuation* to designate those incessant and erratic ebbs and flows of current which are so familiar to us all, due to the starting and stopping of cars, changes of speed, grades, etc. The author referred to the load diagrams obtained in the Minneapolis Street Railway Co.'s station by Prof. Geo. D. Shepardson and Edw. P. Burch, and to that appearing in a paper by Mr. C. J. Field, and compared them with the diagrams obtained in a lighting station, showing the essential difference in the nature if the load. He also referred to curves obtained in the Brooklyn Edison station with two compound engines, one coupled direct to a pair of 100 k. w. dynamos, and the other, a high speed engine, belted to two 70 k. w. Edison generators—both tested under exactly similar conditions. The curves show that by the time the load has fallen 40 per cent. the efficiency drops very rapidly.

It is for the purpose of better utilizing and economizing this power that the storage battery is proposed to be used, by taking advantage of its property of being able to "give and take" energy, and thus keep the load balanced and equalized at all times.

The author then takes up the use of storage batteries in lighting stations and gives two curves showing the performance of the storage batteries installed in the Edison station in Fifty-third street, New York. Their chief function is to relieve the other stations at the hours of heavy load, by delivering into the mains a certain amount of current that would otherwise have to come, and at greater loss or "drop," from one or another of the stations connecting with the network of mains. Hence the load may be varied more or less arbitrarily, at these stations, according to the

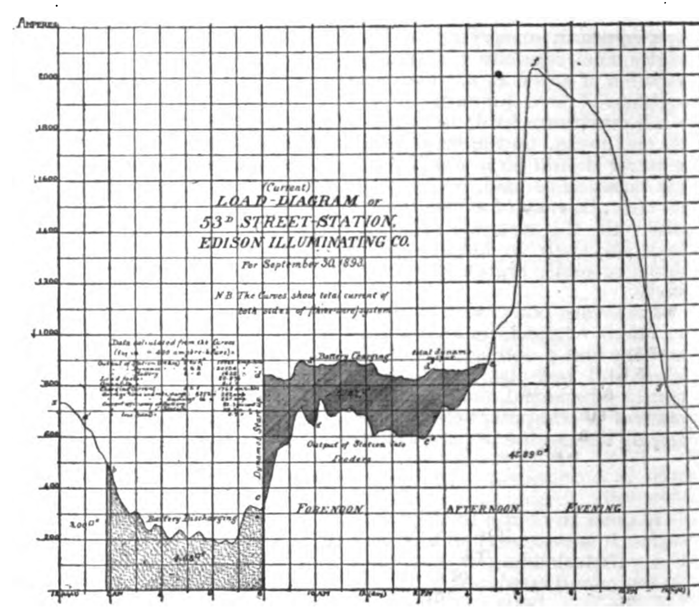


FIG. 1.

proportion of load that the larger stations are desired or able to carry.

The battery is installed on the second floor above the engine and dynamo-room, and consists of 140 cells each of about 1,000 ampere hour capacity, weighing some 750 pounds, and of about 48 inches in length, 21 inches in width and 15 inches in depth. The battery has a normal discharge rate of about 200 amperes, but can be discharged, if necessary, at 500 amperes.

The first curve, giving the record for April 22, 1893, was taken when the station was running only 12 hours per day, from noon to midnight. Calculation shows that the battery furnished about 28.2 per cent. of the total energy delivered to the mains. The maximum rate of discharge attained by the battery was about 270 amperes. Thus, in this case, we have an example of a battery which is used for the purpose, first, of giving a load to station machinery that would otherwise be idle; second, utilizing the stored energy to increase the rate of output of the station at the time of heavy load, which would otherwise necessitate greater dynamo capacity. In the second curve, Fig. 1, taken five months later, the conditions have been changed. In the first place the station output has increased greatly, being now about 2.9 times greater, and it is also continuous. The station now runs from 8 a. m. one day to about 2 a. m. the next day, or 18 hours. When it starts at 8 a. m. it carries a two-fold load; first, the regular load allotted to this station, and second, in addition thereto the current absorbed by the batteries in charging. The total load is much more uniform than if the station were feeding into the mains alone, for the extremes of current fluctuations represent a

1. Abstract of a Report submitted at the Meeting of the American Street Railway Association, Milwaukee, Oct. 18, 1893.

total variation of only 80 amperes on an average load of 850, or less than 9½ per cent. The battery is now being made to play an additional part of some interest. The maximum load has increased to such a point that the station plant is no longer adequate; and consequently the battery is put on to "cap" the summit of the load and supply the excess for current required above the capacity of the dynamos. When the load begins to fall off (about midnight) a part of the plant is shut down; but since the load is still too heavy for the other dynamos, the batteries again serve to supply the excess.

A storage battery has been employed for some time at Germantown, Pa., and one is now being installed in the Boston Edison station; it is also proposed to install one in the Brooklyn Edison station.

In Europe great headway has been made in this branch. In London eight stations aggregating 200,000 lights, are provided with storage batteries. The batteries in some instances being situated in sub-stations. In Paris there are nearly 30 such sub-stations, all charged from the same central station. In the "Edison sector" of the city, an interesting application is made of a large (2,800 ampere hours) battery which is located at a point somewhat distant from the central station, and connected with the mains from which it is charged at those hours when the load is light, by taking current from the mains themselves; the potential being regulated by means of a continuous current transformer. Thus the battery, in this case, saves the cost of larger feeders, while it also furnishes a load for the hours of small load.

This plan suggests itself as of possible service in electric railway systems covering a large area of territory all fed from a single central station. The batteries could be located at distant points, or at such points as would give the best distribution of current to the trolley lines with the least expensive line work. The station machinery would then virtually work at constant load to feed the batteries, which latter would supply the power needed for the car motors. In this way not only would an economy in the cost of conductors be effected, but there would be more uniformity of potential all over the system.

The following table gives some additional stations where storage batteries are used, with various data relating to them:

Location of Station.	Actual Capacity in Lamps.	Rate. Delivery Capacity in Kilowatts.		Quantity. Average Daily Output in Kilowatt hours.		Station Load Factor.	Battery Factors.		Dynamo hours run per 24.	Remarks.
		Dynamos.	Battery.	Station.	Battery.		Rate or Delivery.	Quantity or Output.		
Bremen....	5000	360	......	.... .	......	....	......	.. ...	....	
Hamburg..	9000	787	165	......	......	....	......	......	6	Batt'ry runs 18 hrs. without supervision.
Barmen....	4000	188	193	......	......	....	......	......	....	
Düsseldorf.	6000	105	146	.....	......	....	......	.. ..	....	In 3 sub-stations.
Dessau.....	2000	108	......	......	187	...	......	52	......	Gas Engine.
Gavelsberg	2000	80	33.6	......	.. ...	....	......	......	10	
Gablonz....	1500	60	23	......	......	...	......	......	......	
Dundee....	......	438	22	......	......	....	......	......	......	
Hull........	......	113	22	......	182	....	......	......	......	
Hanover...	14000	840	87	974	425	.479	.104	.436	6 to 8	Battery runs 16 to 18 hours.

As regards the batteries used, the author stated that the principal object to be aimed at was long life and high efficiency even at the expense of increased first cost. The Planté process of formation and its modifications would seem to have proven itself superior to the pasting or Faure process, if one can make a criterion of the fact that at least nine-tenths of the aggregate of the central station batteries used is of the Planté type, or some modification thereof. The Planté batteries are conceded to be, usually, of lower capacity per pound; but on the other hand they have the advantage of being able to carry heavier rates of charge or discharge.

There is probably no storage battery on the market of American manufacture, having as much capacity as 500 ampere hours. In Europe they can be procured up to *five thousand* ampere hours capacity. A cell of the latter capacity, weighing complete some 4,750 lbs., size about 36×39 ins., height about 40 ins., gives an idea of the scale on which the use of storage batteries in European central stations is carried on. It may be added that a further idea of the scale of operation is obtained by examining the plans of central stations such as that of Hanover, where a separate building with four floors about 70×35 feet is reserved for the storage batteries.

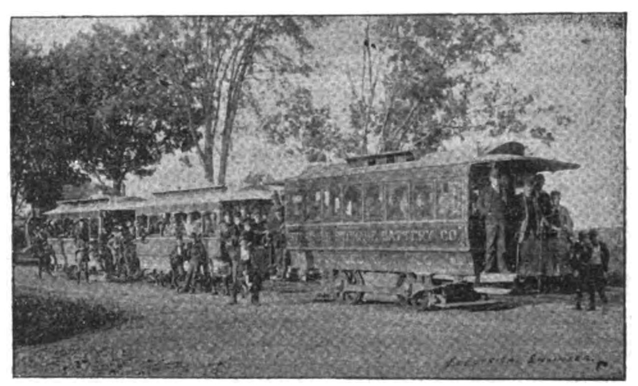
The author also referred to a number of curves showing how the capacity and efficiency of the battery varied with the rate of discharge. To illustrate by an example from actual practice he cites the station at Lyons, France, where the watt efficiency for one month averaged 85 per cent.; at Hanover, 78.4 per cent. for the entire year; at Dessau, 78 per cent.; in the 53d street, New York Edison station, 85 per cent., the figures guaranteed by the makers, the Crompton-Howell Company. As regards the first cost of storage batteries the author found it difficult to obtain exact information. He gives a curve showing the variation in cost with increased size, for the Crompton-Howell cells. The Electric Storage Battery Company, of Philadelphia, which is about to put on the market some large central station cells (up to four kilowatt hours) of a type already in extensive use in France, expects to reduce the cost to $25, f. o. b., per kilowatt hour capacity. The total cost, erected, would be from $30 to $35, according to distance, etc. The cost of imported batteries, erected, would probably range, according to size, from $40 to $65 at the present time.

The maintenance is generally guaranteed by the manufacturer for a fixed annual percentage. At first this percentage was as high as 10 per cent. It was found, however, as the result of improvements that the percentage could be reduced safely. The present ruling cost of maintenance is about five per cent. per annum for a 10-year guarantee. In every case it is stipulated that the battery will be put in as good condition at the end of the 10 years as when first installed.

The author has noted in every case investigated, a scrupulous attention to details large and small, of the installation of the batteries, and of their care and treatment, which contrasts greatly with the way storage battery installations have been usually treated in this country. This may, and doubtless does, account in part for the difference in results obtained. The information gathered on this point, from all sources, seems to warrant the conclusion that storage batteries require attention, not necessarily extensive or expensive, but regulated or systematic attention.

THE SYRACUSE STORAGE BATTERY ON THE ONEIDA STREET RAILWAY.

The accompanying illustration shows the motor car of the Syracuse Storage Battery Company with two trailers attached, as



THE SYRACUSE STORAGE BATTERY CAR, ONEIDA, N. Y.

it appeared on the tracks of the Oneida street railroad, Oct. 7, when the greatest mileage ever before made on the storage system is claimed to have been surpassed. The total run on one charge of the batteries was 125 miles, during which the school children were given a free ride for three round trips over the road, the motor car taking the other cars attached, as shown in the engraving. The sharp curve at Oneida Castle was turned without any apparent extra effort. On September 27, the car took the place of the two horse cars which are used to operate the line, and ran on one charge from 6.50 a. m. to 10.30 p. m., a distance of 117 miles, making enough extra trips to exceed the mileage of the two regular horse cars by 18 miles. The car makes daily from 64 to 90 miles without a break in the service.

The 125-mile run was made on a seven-hour charge. There are 96 cells used in the car. The motor is a single 30 h. p. Rae type with truck made by the McGuire Company, of Chicago. The motor and truck were purchased of the Detroit Electrical Company. The motor is wound for 190 volts. The voltage of the 96 cells at the start of the 117-mile trip was 204; at the end, 192 volts, a loss of only 12 volts in a day's trip. The car is lighted from a bank of 24 cells with 48-volt incandescent lamps. The last trip, which ended at 10:30 p. m., was made in five minutes, a distance of one and two-fifth miles.

THE WORCESTER, MASS., CONSOLIDATED STREET RAILWAY.

THE WORCESTER, MASS., CONSOLIDATED STREET RAILWAY CO., equipped entirely with the type "G" and other material manufactured by the Railway Equipment Co., Chicago, writes to the latter company as follows:

W. R. MASON, Esq., *General Manager Railway Equipment Co.,*

DEAR SIR: We have about completed our overhead work and it ought to be a big advertisement for your company, as we have the most perfectly equipped road in the country. Every part is *first-class.*

JNO. N. AKARMAN, *General Manager,*
Worcester Con. Street Railway Co.

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THE STREET RAILWAY CONVENTION.

THE meeting of the American Street Railway Association, of which we give a report in this issue, has again given evidence of the value to the members of such an organization. The papers read and discussed at Milwaukee contain much of interest and show that the question of "power" is still occupying the attention of street railway managers. Incidentally the influence upon such plants which the introduction of storage batteries can exert was brought out prominently in the paper read by Mr. C. O. Mailloux, whose report on the subject, begun in this issue, will be found of the utmost interest. While on this subject we cannot refrain from pointing out, as hinted at in one of the papers read, that the efficiency of a power plant, independent of the type of engine and other equipment, will depend largely on the way in which it is operated, or, in other words, upon the ability of the superintendent. In the praiseworthy effort to avoid all needless expense, street railway companies are liable to go to the opposite extreme and, by employing incompetent persons in places requiring great responsibility, they have frequently, unconsciously, followed the penny-wise and pound-foolish practice. But most striking of all the features of the convention was the entire absence of any reference to the horse as a factor in street railway work. Time was when this subject occupied most of the attention of the Association and its relegation to oblivion shows how thoroughly electric traction has come to be considered the method *par excellence* for city traffic.

THE AWARDS AT THE WORLD'S FAIR.

IN our World's Fair department we have recently published brief notes on the number and proportion of the awards distributed to exhibitors. Judging by the comparatively small proportion of the number of awards to the number of exhibitors, and more particularly to the number of exhibits, it is apparent that the judges have been painstaking and discreet in their work. Whatever objection may have been urged against the scheme of awards devised by Mr. John Boyd Thatcher, the fact remains that the method pursued gives each recipient of an award a distinct and individual diploma, stating the particular merit of his exhibit or exhibits. While the awards given under this system can hardly be called competitive in the true sense of the word, the method has the advantage of stating in exact terms in just what points the apparatus of an exhibitor excels, and of giving him a substantial basis for such claims in the prosecution of business. We cannot let this occasion pass, however, without deploring the fact that the exhibition authorities made practically no provision, either in apparatus or in a pecuniary way, for carrying on tests, and it is but scant recognition to say that but for the zeal of the judges themselves and the interest which they took in their work,—frequently prosecuted under the most discouraging conditions,—this, the greatest of all electrical displays, would have passed by without a record of the true merits and capacities of the apparatus exhibited.

LOCAL MEETINGS OF THE INSTITUTE.

AT the monthly meeting of the American Institute of Electrical Engineers, October 18, the following preamble and resolution were adopted:

Whereas, requests and suggestions have been received from members in various parts of the country looking to the holding of local meetings for the reading and discussion of papers, and

Whereas, it is the sense of this meeting that any measures proposed with the view of increasing the usefulness of the Institute to its distant members should have earnest consideration and careful action, it is hereby

Resolved, that the President be requested to appoint from the Council a committee to consider the subject of local meetings; such committee to be supplied with copies of all correspondence and papers on the subject in the files of the Secretary, and that the Council report as early as possible to a monthly meeting of the Institute: First, upon the expediency of local meetings; and second, if they deem such meetings expedient, to recommend a suitable plan for the organization of local meetings and for their proper relation to the general body.

From this action it is hoped there will result a well considered and comprehensive plan for establishing local meetings wherever, at distant points, a sufficient number of members are to be found and who desire to conduct them. The subject of such meetings has been informally discussed many times, and has now been brought into prominence by the enquiries and suggestions of Dr. Perrine at the annual meeting in May touching possible meetings on the Pacific Coast—and by the more recent movement at Chicago and Lynn.

It is quite obvious in view of the wide dispersion of the members, that some way of securing a more active participation in the work of the Institute on the part of members far distant from New York is extremely desirable; not less for the advantage of the national body as a whole, than for that of its scattered members. The plan should be broad enough to give character and significance to such local assemblies as may be established, while conserving the status and headship of the general body of the Institute.

TROLLEY ACCIDENTS AND CAR BRAKES.

WE publish in this issue another communication from Mr. E. H. Johnson, in which that gentleman sums up very pithily the various opinions which have been vouchsafed as to the cause of trolley accidents and the remedy therefor. He summarizes the whole in two propositions and calls for a prescription that will rid the trolley car of a dangerous disease. We hope that Mr. Johnson's call will not remain unheeded. It would, indeed, be strange that among the many who have aided in bringing the electric car to its present state of perfection none should be found able to overcome one more difficulty in addition to the thousands which have already been conquered in the past.

TWELFTH ANNUAL CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION, MILWAUKEE, WIS., OCT. 18 AND 19, 1893.

THE Twelfth Convention of the American Street Railway Association, began at 10.30 a. m. on Oct. 18, in the Exposition Building, Milwaukee. An address of welcome was delivered by Mayor JOHN C. KOCH. President D. F. LONGSTREET, of the Denver West End Road, made a brief and pithy address, when Secretary RICHARDSON read an interesting report from the executive committee, which showed that there are now 197 companies in membership. As to the formation of the proposed Industrial Institute in connection with the Association, the matter was recommended for further serious consideration by the members. Reference was also made to a few legal cases and to the deaths of four members. He then read a brief abstract of his report as secretary and treasurer, showing:

Receipts	$8,763.77
Disbursements	6,540.78
Balance	$2,222.99

Mr. Richardson then read the special report from Mr. E. G. Connette, of Nashville, Tenn., on "Power House Engines."[1]

The report was also signed by L. H. McIntire, of Philadelphia, and F. S. Pearson, of Boston.

MR. CONNETTE supplemented his report by recommending as preferable the vertical type as economical of space, and easy to operate. He referred, as a favorable example, to the large Lake Erie vertical engine at the World's Fair Intramural Plant, which had been carrying a very heavy load all the time, without expenses for repairs, and without shutting down.

MR. BION J. ARNOLD, as one of the consulting engineers of the Intramural road, spoke of the work there and said that he thought the horizontal engines had stood up almost equally well, except perhaps in regard to a little attention to cylinder wear. He hoped for the time when the higher initial expense of vertical engines would not stand in their way. The Intramural road showed, moreover, that it was better to have engine and generator of the same rated capacity, and not for the engine to be 20 or 25 per cent. higher capacity. He thought that on all our types of engines they were coming to a speed of 125 revolutions.

The convention then adjourned until the evening session at 8.

WEDNESDAY EVENING SESSION.

MR. O. T. CROSBY, being called upon to give his opinion of the relative conditions of the power required in generator and engine said: The question is in regard to the proper proportion to be established between the rated capacity of dynamos and engines. I have used the term rated capacity, because I know that the discussion, as far as it has gone was based upon proportions between rated capacity. What we want to get at, I fancy, is the ratio between the real capacity of engines and dynamos. I have believed for some time that the best practice is that an engine should be at least no greater in capacity than the dynamo to which it is attached. The engine will certainly not do its work as economically if it be run ordinarily at a considerably lower output, than the output for which it has been calculated as a normal output. The dynamo does not suffer by any means so badly in thus being brought below its rated work. If, therefore, an engine of 600 h. p. be attached to a dynamo of 500 h. p., the man running the station will ordinarily, and very properly, limit the load, which is thrown on the couple, since they now constitute a couple, below the capacity, as he understands it, of the dynamo, rather than of the engine. He will endeavor to keep within safe limits with respect to his dynamo. In thus keeping within safe limits with respect to his dynamo he is keeping too far under the limit with respect to the engine for economical work. The dynamo is not what you should have unless it can be run at its rated load without any injury. If at the same time you are running the engine at about its rated load, you are getting perfectly satisfactory results in both cases as to repair, and the best results in both cases as to the efficiency of output, and that is probably the largest question involved in the whole matter. I have had some conversation with engineers both in the field in which I am interested and those in charge of power stations, and I find that this opinion is becoming quite well fixed—that the generator and engine should be at least equal, with some in favor of having an engine slightly lower in rated capacity than the dynamo. I am told by the representative of a large firm of engine makers in this city that most of the complaints that they receive from their customers are due to the fact that they were running the engines at lower than their proper load.

There is another point, as between vertical and horizontal engines. I do not think the matter as far as it went this morning was presented just as it seems to me it should have been. There is no difference in the machines, intrinsically, as to their value. You can make a splendid vertical engine, and you can make a splendid horizontal engine. No doubt some of my hearers will think me a "mugwump" on this question; it is impossible to speak on these subjects with as much definiteness and emphasis as many would like; but you can take a particular case and work it out to a greater degree of accuracy than you suppose. A vertical engine, as compared with a horizontal engine, involves a difference in the space occupied; and space represents money, investment; and there, in my opinion, is the meat of the whole question. There is enough experience in the engineering practice to justify us in feeling that vertical engines and horizontal engines are almost equal in value as driving power. Speaking for the electric side, it is a matter of indifference to the generator how it is driven. You want to consider in the most careful way the cost of all those elements in your plant—the engine complete, with all its appurtenances, and the space occupied and the economy of its operation. If you approach the question in the broadest way, I believe you may be inevitably led to the use of a vertical engine on real estate considerations, more than any other—interest charges. I believe that the real estate consideration, the price per square foot of your building, is the determining element in large plants, as to which of the two types it is best to use. It is largely the same question which usually determines as between the condensing and the non-condensing engine. It still remains that the condensing process saves just so much coal, but may cost just so much extra investment. I heard it stated the other day by a competent engineer that the condensing process, when coal is in the neighborhood of three dollars a ton, may justify an investment of one hundred dollars per horse-power to bring it about. The analogy between the cases of condensing and non-condensing engines, and between vertical and horizontal engines is very close. You can get an excellent plant either way.

We are now all very much interested in the large direct coupled work which we see about us, certainly none more so than those who have built the plants. At the same time I would not want anyone to feel that a belted station is not entirely a satisfactory plant. I believe heartily it is. I believe in that case, as in others, you want to consider your original cost of all the elements.

A letter was read from the West Germany Street Railway Association, sending greetings to the American Street Railway Association, and requesting an exchange of annual reports.

A paper was then read by Mr. G. F. GREENWOOD, of Pittsburgh and Manchester Traction Company on "The Best Method of Lighting and Heating Street Railway Cars." It was a comprehensive review of the subject but did not regard electric car heating very favorably, speaking of it as "the system of three conversions." It stated that to install four such heaters in a car with some form of regulating switch cost from $35 to $45, installed; while the cost of current ran from 32.4 cents per car per day in moderately cold weather up to 81 cents in severely cold weather. To this must be added depreciation and repairs, at 20 per cent., adding 5.1 cents per day, the day being one of 18 hours. Moreover, the use of such heaters meant an increment to the expense of operating the road, by requiring additional power plant. As to electric car lighting, the paper was more optimistic, and stated that with all electric lights, in head, colored signal, and ceiling, making five lights, the cost ran only about 4 cents per day, estimating that a car would burn its lights eight hours on the average. Mr. Greenwood adopts this system and uses no oil or gas lamps at all.—There was no discussion of the paper.

The report of the COMMITTEE ON STANDARDS was called for. MR. O. T. CROSBY, chairman of the Committee, reported that no written report had been prepared; that the Committee regretted not having a report ready, but it was unvoidable.

On motion, the Committee was continued another year.

THE PRESIDENT announced the next business to be a Report from the Committee on "Can the T-rail be satisfactorily used in paved streets?"

A letter from MR. C. DENSMORE WYMAN was read, the Committee on this subject, in which he regretted his inability to prepare a report, owing to the demands of other duties.

THE PRESIDENT then requested a discussion of the subject by the meeting.

The discussion on this subject was then participated in by Messrs. HURT, of Atlanta, HENDRIE, of Detroit, BURKE, of Terre Haute, and ARMSTRONG, of Camden. The evidence went very strongly to show that T-rail laid in brick streets, or on those with wood and granite blocks, proved quite satisfactory, and as much so to the public as to the companies. The impression appeared to be that companies might hope for better treatment hereafter in introducing T-rail. A Committee will probably report on the subject of rails and street construction next year, as the subject has grown in vital importance since the companies have had so much street building work to do themselves, under their new franchises.

The meeting then adjourned until Thursday at 10 a. m.

THURSDAY MORNING SESSION.

The first business was the reading by MR. C. O. MAILLOUX, of his paper on "Storage Batteries in Connection with Central Stations for Utilizing Surplus Energy for Lighting or Power."[1]

1. See page 365, this issue.

1. See page 366.

This was followed by a paper from Mr. Elmer E. Sperry on "Traction and Street Railway Tracks."

THURSDAY AFTERNOON SESSION.

A paper by Mr. C. J. Field[1] on "Direct Driven Generators"[2] was read.

This was followed by a paper on "Magnetic Cut-Outs for Cars" Mr. W. E. Harrington, electrician of the Camden, N. J., electric road.

Mr. Lang, as chairman of the nominating committee, reported that the committee recommended the following officers: President, Henry C. Payne, Milwaukee, Wis.; first vice-president, W. J. Stephenson, Washington, D. C.; second vice-president, James R. Chapman, Grand Rapids, Mich.; third vice-president, Lewis Perrine, Jr., Trenton, N. J.; secretary and treasurer, W. J. Richardson, Brooklyn, N. Y.

Executive Committee: D. F. Longstreet, Denver, Col.; Thomas H. McLean, Indianapolis, Ind.; Edward Whittaker, St. Louis, Mo.; W. Y. Soper, Ottawa, Canada; E. S. Goodrich, Hartford, Conn.

A motion was then made that Mr. Rugg, of Pittsburgh, cast the ballot of the Association for the gentlemen named.

It was voted to hold the next Convention at Atlanta, Ga., although a pressing invitation also came from Mr. Lusher, to favor Montreal with a call later on.

The President: It has been suggested that there is a gentleman present who can give the convention some interesting information about the conduit trolley system joined to an overhead system. The gentleman is Mr. Herbert Claude of the Rock Creek road, of Washington, D. C.

Mr. Claude: I will simply say that in Washington we have an underground conduit connected to our overhead trolley. It is about a mile and a half long, of double track. We had already laid about a mile of track in the city, when we found we could not put up our overhead poles. The question came up right away what we were to do, and what system should be put on the track. Of course, we had the Buda-Pest system to go by, which for a year or two back, has been running successfully, we understood, but we did not feel disposed to go to work to contract for something to be put up there which we were not sure of, that was not made in this country, and in which the voltage was different from what we were using on our overhead lines. We put down a mile and a half of track, and have had it in operation since the 4th of last March. It runs to the outskirts of the city and then joins to the overhead trolley. The cars are run up to this intersection on the underground trolley. It has been run successfully from the day it started until this time. We are using the same cars and same motors. We built a separate and distinct power-house, to give it a thorough test. We know it is a success, and I do not see any reason why, if it will run for a mile and a half, it will not run for any distance. It can be continued as any ordinary line is continued. The current is the same. It is simply the overhead line with the wires underground. It is the Love system. Mr. M. D. Law, who built the conduit, and put the wires in, is present. I think it will be interesting if you will allow him to say a few words on the subject.

Mr. Rigg, of Reading. Have you operated this road during cold weather?

Mr. Claude: It has been operated since the 4th of last March. We did not have any very cold weather during March; we had some snow. In the overhead system, the return current comes back through the rail. If it is covered with sleet and ice, it gives a great deal of trouble, as you know. The underground system does not give us any trouble in such cases, for the current is returned in the wire in the conduit, and we do not depend on the rail for the return current at all. It makes no difference how much snow there is on the rail, you go ahead just the same. In regard to the conduit filling with snow, I do not think there is any chance of its filling completely. It can be looked after just as the snow is looked after on top. I run a sweeper through it once a week; a broom that fits the conduit is attached to the car, and the car goes along and the conduit is swept out. Every hundred feet there is manhole and trap, and the dirt drops below the conduit, and this refuse drops there and a cart comes along and it is taken up. Snow, I think, can be looked out for in the same way. The slot is only ⅝ inch, and I do not think that much snow will drop down that. I think the snow can be looked after with the broom in the same way.

Mr. Connette: I would like to have you explain as to the manner in which it is constructed, and how the trolley wire is suspended.

Mr. M. D. Law then gave a very clear description of the Love system, a full account of which has already appeared in The Electrical Engineer.[3] He added certain details going to show that the system is thoroughly operative in all weathers and in spite of severe rain storms. In reply to inquiries he stated that no trouble had been experienced from moisture, or leakage of current. The cost, he believed, was about $35,000 per mile of single track. The thing was altogether feasible.

A letter was read from Mr. C. W. Price publisher of the *Electrical Review* suggesting the propriety of some legislation to prevent children playing on street cars and street car tracks.

Mr. G. W. Baumhoff moved the following resolution:

Resolved, that the Executive Committee be requested to draft a suitable memorial to the various state legislatures and municipalities asking them on behalf of the American Street Railway Association to enact laws to prohibit the common practice of children jumping on and off moving cars, and that copies of the same be furnished each member Company of this Association.—Carried.

Mr. A. E. Lang moved that the Convention return its thanks to the Milwaukee Street Railway Company and the various enterprising men in the city, and all who had extented special invitations, for their kind and hospitable treatment while the Convention has been in session.—Carried.

The meeting then adjourned.

BANQUET.

The annual banquet was held in the dining-hall of the Hotel Pfister on Thursday evening. There were 250 guests present. The hall was beautifully decorated, and there was an abundance of floral display and good music.

An interesting feature was the presentation by the Milwaukee Street Railway of a sterling silver souvenir spoon to each one present.

The following is a list of the toasts, Mr. D. F. Longstreet, acting as toastmaster:

"Transportation and Civilization."—Hon. J. G. Flanders.

"Street Railway Employees and the Public."—Hon. Ogden Fethers.

"The Earlier Days and Methods of Street Railways."—Hon. Winfield Smith.

"My Electric Sweetheart, a Poem."—J. H. Stedman.

"The Press."—Horace Rublee.

"Street Railway Men, Past, Present and Future."—H. H. Windsor.

Remarks were also made by Wm. Richardson, Hon. George W. Peck and Henry C. Payne.

LIST OF STREET RAILWAY DELEGATES AT THE CONVENTION.

E. A. Armstrong, Camden, N. J.; Jas. Adkins, St Louis, Mo.; S. K. Ashton, Jr., Milwaukee, Wis; T. Ahearn, Ottawa, Can.; J. A Atkinson, Burlington, Ia.

E. A. Bradley, Waterbury, Conn.; G. W. Baumhoff, St. Louis, Mo.; W. H. Brenner, Montreal, Can.; J. H. Berkford, Scranton and Reading, Pa.; N. F. Baker, Washington, D. C.; F. Wayland Brown, Youngstown, Ohio; T. M. Burt, Berlin, Ontario; E. Binner, Dayton, Ohio; A. Bartlett, Los Angeles, Cal.; Julius Bimminger, Milwaukee, Wis.; Danforth Becker, Milwaukee, Wis.; T. P. Bailey, Kalamazoo, Mich.; M. K. Bowen, Chicago, Ill.; D. A. Belden. Aurora, Ill.; H. P. Bradford, Cincinnati, Ohio; Isaac Blum, Philadelphia, Pa.; R. S. Brown, Gloucester, Mass.; M. F. Burke, Terre Haute, Ind.; A. F. Breed, Boston, Mass.; G. G. Browning, Camden, N. J.; W. J. Ballard, Dubuque, Ia; J. H. Bickford, Reading, Pa.

E. G. Connette, Nashville, Tenn; Ried Carpenter, Mansfield, Ohio; B. E. Charlton, Hamilton, Ont.; John G. Candee, Bangor, Me.; O. T. Crosby, New York City; A. Colliander, Chicago, Ill.; J. M. Christopher, Baltimore, Md.; W. F. Carr, Roanoke, Va.; T. E. Crossman, Brooklyn, N. Y.; C. G Convers, Hot Springs, Ark.; W. S. Cameron, Jamestown, N. Y.; C. B. Clegg, Dayton, Ohio; D. B. Corwin, Dayton, Ohio; R. C. Crawford, Chicago, Ill.; Leverett Candee, New Haven, Conn.; E. P. Clarke, Los Angeles, Cal.; F. A. Colby, Rockford, Ill.; H. J. Crowley, Atlanta, Ga.

H. A. Dixon, Port Huron, Mich.; N. E. Degen, Manistee, Mich.; T. J. Durnin, Milwaukee, Wis.; H. M. Doremus, Bridgeport, Conn.; W. H. Delaney, New York, N. Y.; Robt. Dunning, Buffalo, N. Y.; C. K. Durbin, Denver, Col.; W. W. Dean, Hamilton, Can.; W. D. Dickison, Great Falls; A. Dixon, Port Huron, Mich.; C. A. Derr, Charlotte, N. Y.; E. Duncan, Dubuque, Ia.; J. Dean, Hamilton, Ont.; E. E. Downs, Kalamazoo, Mich.; N. A. Davis, Cincinnati, Ohio.

H. A. Everett, Cleveland, Ohio; Frank Edwards, Lincoln, Neb.; C. E. Ellis, Philadelphia, Pa.; Miller Elliott, Pittsburgh, Pa.

Francis Fenimore, Phœnixville, Pa.; T. C. Frenyear, Gloversville, N. Y.; C. E. Flynn, Peoria, Ill.; E C. Foster Boston, Mass.; W. B. Ferguson, Haverhill, Mass.; L. M. Flesh, Piqua, Ohio; C. R. Frederick, Davenport, Iowa; J. D. Fraser, Ottawa, Can.; John Fritz, Bridgeport, Conn.; J. H. Fry, Detroit, Mich.; W. H. Foster, Pittsburgh, Pa.

W. C. Gotshall, Munroe, Ind.; Andrew Glass, Washington, D. C.; W. W. Goodwin, Detroit, Mich.; E. S. Goodrich, Hartford, Conn.; G. F. Greenwood, Pittsburgh, Pa.; T. F. Grover, Milwaukee, Wis.; E. H. Guyer, Moline, Ill.; Alfred Green, Rochester, N. Y.; John B. Gorman, Worcester, Mass.; Frank R. Greene, Chicago, Ill.; J. W. Greer, San Antonio, Tex.; W. H. Griffin, Galveston, Tex.; C. E. Goodrich, St. Paul, Minn.; John Grant, Detroit, Mich.; J. Gunn, Toronto, Can.

Geo. D. Haynes, Newark, N. J.; Joel Hurt, Atlanta, Ga.; J. E. Haynes, Newark, N. J.; R. H. Holbrook, Cedar Rapids, Ia; F. T. Hilgard, Milwaukee, Wis.; C. W. Hahn, Milwaukee, Wis.; F. G. Hubbard, Milwaukee, Wis.; T. E. Howell, Dayton, Ohio; A. H. Hayward, Allentown, Penn.; W. S. Hatch, Detroit, Mich.; S. Hendrie, Detroit, Mich.; J. F. Hoffman, Milwaukee, Wis.; N. H. Heft, Bridgeport, Conn.; D. F. Henry, Pittsburgh, Pa.; W. S. Heger, Wilmington, Del.; A. E. Hay, Chambersburg, Pa.: John Hulsizer, Joliet, Ill.; W. E. Haven, Fishkill-on-Hudson, N. Y.; Russell B. Harrison, Terre Haute, Ind.; Henry Hayes, New Britain, Conn.; J. D. Hawks, Detroit, Mich.; P. E. Hurley, Trenton, N. J.

E. B., Ives, Philadelphia, Pa.

T. M. Jenkins, Covington, Ky.; W. S. Jewell, Anderson, Ind.; F. G. Jones, Memphis, Tenn.; J. W. Johnson, Kalamazoo, Mich.

H. R. Keithley, Chicago, Ill.; B. L. Kilgear, Cincinnati, Ohio; H. Klinkerfus, Milwaukee, Wis.; G. W. Klau, Milwaukee, Wis.; J. W. Kolbe, Baltimore, Md.; W. T. Kelly, Columbus, Ohio; I. A. Kelsey, New Haven, Conn.; Perot L. Knowles, Phœnixville, Pa.; W. W. Kingston, Montgomery, Ala.

Preston Lea, Wilmington, Del.; Albion E. Lang, Toledo, Ohio; M. D. Law, Washington, D. C.; Chas. F. Luther, Pawtucket, R. I.; A. W. Lynn, Milwaukee, Wis.; E. Lusher, Montreal, Can.; Richard Lockey, Helena, Mont.; H. M. Littell, New Orleans, La.; D. F. Lewis, Brooklyn, N. Y.; M. W. Lipper, Philadelphia, Pa.; H. H. Littell, Buffalo, N. Y.; D. F. Longstreet, Denver, Col; J. C. Liggett, Detroit, Mich.

T. H. McLean, Indianapolis, Ind.; J. W. McNamara, New York City; Geo. C. Morse, Taunton, Mass.; Chas. McLaughlin, Paterson, N. J.; G. J. Melmes, Wilwaukee, Wis.; A. McNaughton, Milwaukee, Wis.; C. J. Melms, Paterson, N. J.; C. H. Macloskie, Chicago, Ill.; J. M. May, Iowa; G. W. Maslin, Brooklyn, N. Y.; C. K.

1. See page 364.
2. See page 376.
3. See The Electrical Engineer, Sept. 21, 1892.

Minary, Springfield, Ill.; J. S. Minary, St. Louis, Mo.; L. J. Macfarren, Pittsburgh, Pa.; L. H. McIntire, Philadelphia, Pa.; Ferdinand Marks, Philadelphia, Pa.; J. L. Macartney, Norfolk, Va.; —— McClory, Birmingham, Ala.; H. W. Morris, Milwaukee, Wis.; Richard McCulloch, St. Louis, Mo.; C. A. McKinney, Houston, Tex.; A. Markle, Hazleton, Pa.; H. T. Morton, Ann Arbor, Mich.; J. P. McQuaide, Norristown, Pa.; C. O. Mailloux, New York City; J. B. McGiffert, New Britain, Conn.; I. F. Macartney, Norfolk, Va.; C. S. Hendell, New Bedford, Mass.; H. A. Mock, Brooklyn, N. Y.; W. N. Morrison, Brooklyn, N. Y.; G. F. MacDonald, Ottawa, Can.; Edward Martin, Hamilton, Ont.; W. L. Mason, Milwaukee, Wis.

J. F. Ostrom, Steelton, Pa.; Chas. Odell, Newburyport, Mass.

C. H. Pierson, St. Louis, Mo.; W. H. Patterson, Bloomington, Ill.; John Partridge, Brooklyn, N. Y.; Geo. A. Phillips, Milwaukee, Wis.; T. C. Pennington, Chicago, Ill.; Thomas Pidd, Milwaukee, Wis.; Lewis Perrine, Jr., Trenton, N. J.; Mason D. Pratt, Steelton, Pa.; H. P. Perrine, Trenten, N. J.; H. T. Potts, Philadelphia, Pa.; H. C. Payne, Milwaukee, Wis.; Frank C. Peck, Kansas City, Mo.

Wm. Richardson, Brooklyn, N. Y.; W. B. Rommell, Pittsburgh, Pa.; M. H. Routzohn, Dayton, Ohio; T. C. Rusling, Chicago, Ill.; W. J. Richardson, Brooklyn, N. Y.; H. B. Rogers, Brockton, Mass.; W. P. Read, Salt Lake City, Utah; J. A. Rigg, Reading, Pa.; J. E. Rugg, Pittsburgh, Pa.; Andrew Radel, Newark, N. J.; Lewis H. Rogers, Cleveland, Ohio; G. F. Reed, Springfield, Mass.

J. R. Smith; A. O. Shepardson, Waterbury, Conn.; Walter C. Smith, Milwaukee, Wis.; Clement C. Smith, La Crosse, Wis.; D. W. Sullivan, Brooklyn, N. Y.; Harry Scullin, St. Louis, Mo.; S. Schloss, Detroit, Mich.; A. P. Smith, New Bedford, Mass.; H. B. Sinclair, Galveston, Tex.; P. T. Sullivan, Lowry, Mass.; J. R. Sterling, Detroit, Mich.; W. J. Stephenson, Washington, D. C.; A. L. Stone, Oakland, Cal.; E. A. Sperry, Cleveland, Ohio; W. S. Scull, Camden, N. J.; C. M. Swift, Detroit, Mich.; Allen Shewmon, Racine, Wis.; E. P. Shaw, Jr., Norwich, Conn.; W. Scheerer, Newark, N. J.; F. H. Sloan; W. H. Smith, Omaha, Neb.; J. J. Sullivan, Philadelphia, Pa.; W. H. Shelmerdine, Philadelphia, Pa.; W. C. Smith, Pittsburgh, Pa.; W. A. Stern, Philadelphia, Pa.; W. Shaffer, Asbury Park, N. J.; E. P. Shaw, New Haven, Conn.; W. W. Sargent, Fitchburg, Mass; J. F. Shaw, Newburyport, Mass.

J. G. Traggard, Pittsburgh, Pa.; E. F. Tindolph, Vincennes, Ind.; E. M. Tourley; F. A. Ticknor, Rockford, Ill.; A. C. Thompson, St. Louis.

C. C. Upham, Lincoln, Neb.

John Valentine, Portland, Ore.

Paul Winsor, Boston, Mass.; Gen. Chas. Williams, Manchester, N. H.; Chas. L. Williams, Rochester, N. Y.; L. R. Wright, Denver, Col.; Franklin Woodman, Haverhill, Mass.; Geo. K. Wheeler, Dubuque, Ia.; Elias S. Ward, Newark, N. J.; H. H. Wood, Birmingham, Conn.; H. C. Whitehead, Norfolk, Va.; Henry F. Woods, Boston, Mass.; M. J. Wightman, Middletown, N. Y.; R. S. Woodruff, Trenton, N. J.; G. K. Wheeler, Kalamazoo, Mich.; F. H. Whitney, Milwaukee, Wis.

B. H. Yeates, Chicago, Ill.; A. M. Young, New Britain, Conn.

CONVENTION NOTES.

AFTER the morning session on Wednesday, the delegates and friends were taken in special trolley cars to the enormous works of the Edward P. Allis Co., the builders of the celebrated Reynolds-Corliss engine and of many other mechanical appliances. The reception given was most cordial and a liberal lunch was provided, after which an hour was spent strolling through the shops, and especially through the engine department which was found very busy. A number of engines of the 1890 type and brothers of the colossus in the Intramural World's Fair road, were seen in course of construction.

After this, the delegates were taken to the Kinnickinnic repair house and car station of the Milwaukee Street Railway Co., where a number of interesting things were seen, including a light emergency wagon for quick street patrol work, built by the company.

Thence the party proceeded to the huge Empire brewery of the Pabst Brewing Co., where every branch of the art of beer-making was studied and where the rush and activity gave no sign of dull times. An adjournment was then made to an al fresco bier garten where Pabst's finest was served, with pretzels, and where a pretty little souvenir pamphlet was distributed, with a miniature bottle of Bohemian beer.

Thus cheered and reinvigorated, the party took to the cars again and were carried to the fine power house of the Edison Illuminating Co. and the Milwaukee Street Railway Co., of the latter of which Mr. H. C. Payne is the efficient vice-president and general manager. The building is solid to a degree. The railway generating plant has a capacity of 4,000 amperes at 500 volts, and the illuminating plant has a capacity of 14,000 amperes at 110 volts. There are now connected to the Edison underground system of 15 miles of three-wire mains and feeders 16,000 lamps of 16 c. p.; 445 h. p. of motors and 70 arc lights. The railway plant takes care of 200 motor cars, and there are 37 miles of railway feeder system. Milwaukee, by the way, has probably more centre pole construction than any other city in the Union, and certainly is not equaled in this respect by any other city below 250,000 inhabitants.

The boiler plant of this fine power house comprises 18 Galway internally fired boilers of a total of 5,000 h. p., at 160 pounds pressure. There is an ingenious coal and ash conveying system supplied by the Link-Belt Machinery Co., of Chicago. The switch boards are of white marble on iron frames. The plant includes the Henderson marine engine and direct connected Edison multipolars, while in the railway plant there are also two 500 h. p. units for which the engines were furnished by the Filer-Stowell Co. of Milwaukee.

THE WISCONSIN TELEPHONE CO. extended to members the privileges of its long distance lines, for talking to New York, Boston, Philadelphia and other remote eastern cities. The courtesy was largely availed of.

ON Tuesday evening, Mr. and Mrs. Henry C. Payne gave a dinner at the Milwaukee Club to the officers of the Association and the members of the Executive Committee. It was a delightful occasion, to be long remembered by the participants.

MR. HENRY C. PAYNE, the new president of the Association made a decided hit with his happy and ingenious selection of a permanent souvenir. It took the shape of a spoon of sterling silver, having engraved in the bowl a picture of Mr. Payne's private car, No. 200, done to the life. The spoon bears date Oct. 20, 1893. The handle is in scroll rococo, and the whole is quite dainty and pretty. It is understood that Mr. Payne had 600 of these spoons prepared for the occasion, to distribute among members and other visitors.

ELECTRICAL MEN felt more than ever that they had "met the enemy and they are ours" when Mr. Payne was elected to the presidency. As an old time telephonist and electric light manager he has long been known to the electrical industry, while the growth of his street railway system has simply expanded his field of usefulness and influence. Peculiar significance was further given to this by the presence at the Convention and active participation of Judge Armstrong of Camden, N. J., president of the National Electric Light Association. He is in fact as much interested in electric roads as in electric lights, and fully realizes the desirability of watching closely each successive development of the electric arts.

GREAT credit is due the local and entertainment committees for their work. The committee comprised Messrs. H. C. Payne, Geo. W. Hommell, Geo. Kemmerlein, A. W. Lynn, R. S. Stikeman, Otto A. Rau, G. O. Wheatcroft, W. L. Mason, C. L. Jones, W. C. Vandenberg, W. Goltz, G. J. Melms, T. J. Durnin, A. McNaughton, E. D. Hoyt, A. B. Myers. All these gentlemen are actively connected with the Milwaukee Street Railway Co., the Milwaukee Electric Railway Co., the West Side Railroad Co., the Wauwatosa Electric Line or the Wauwatosa Dummy Line. They left nothing undone for the pleasure and comfort of their visitors. It may be added that books of car tickets were issued free to all registering delegates and friends.

EXHIBITS.

MR. WILLIS H. POST, Detroit agent of A. L. Ide & Son was in attendance.

W. A. MCGUIRE, W. J. COOK, J. A. HANNA and M. G. HUBBARD, represented the McGuire Truck Company.

C. M. FULLER, again represented the Davis Car Shade Co., showing their well-known Davis automatic car curtains.

MR. ELMER A. SPERRY AND MR. L. H. ROGERS, represented the interests of the Sperry Electric Railway Co., of Cleveland.

MR. J. J. KENNELLY, superintendent of construction of the Sterling Supply Company, was in attendance at the Convention.

MR. W. L. ADAMS, of W. L. Adams & Co., formerly with the Railway Equipment Co., was among the many daily seen around headquarters.

THE PAWTUCKET BRASS FOUNDRY made a splendid exhibit of motor bearings, of which they make a specialty. Mr. Chas. N. Wood was in charge.

MR. W. C. MCGUIRE, W. J. Cook, V. P., and Mr. J. A. Hanna, Gen. Agt., were there in the interests of the McGuire Truck Co. of Chicago.

PROHL & FIELDER, of Milwaukee, showed a neat little device gotten up for street-car patrons living in towns and cities using metallic, celluloid and analogous tickets.

S. B. COUDET, general agent of the Shawmut Fuse Wire Company, showed a full line of samples of this company's products. Also the new Shawmut self-oiling trolley.

THE W. T. C. MACALLEN CO. exhibited a large line. Their special sheet mica circuit breakers and insulated crossings came in for a good share of favorable criticism.

MR. A. H. ENGLUND, secretary and manager of the International Register Company, showed their splendid devices for registering fares including portable and stationary registers.

THE 96 EXHIBITS in Exposition Hall meant that some people were looking for business. This was the number installed up to Thursday noon. The supply men are ever on hand.

P. C. ACKERMAN was at the Convention. Did he ever miss one? American Electrical Works products will never loose their popularity while their interests are intrusted to him.

MR. J. HENRY CARSON, president and general manager, and Mr. Howard Wheeler, general agent of the Sterling Supply Co., showed a line of their street railway supplies.

MR. E. H. PINKHAM, showed his improved electric sand box. This box possesses some novel features and should become popular. It is made by the Pinkham Car Track Sander Co., Boston, Mass.

MR. C. S. VAN NUIS was present representing his Ajax switches, but did not make an exhibit, as everybody had been to visit his space in the Transportation Building at the World's Fair

R. D. NUTTALL CO.—The interests of the R. D. Nuttall Co. were intruted to Mr. J. M. Denniston. An interesting souvenir was given out in the form of a miniature section of a rawhide pinion.

THE CHAS. SCOTT SPRING COMPANY, of Philadelphia, Pa., made as usual an interesting exhibit of their elliptic and other springs. Mr. Chas. Scott, Jr., and Mr. Harry C. Johnston were on the ground.

THE MUNSON BELTING COMPANY had an interesting exhibit of their belting. Those on the ground representing the company were Mr. W. C. Groetzinger, Col. J. H. Shay, electrician, and Mr. H. E. Skinner.

Mr. F. A. PULLMAN represented the Pullman Electric Company of 44 South Jefferson street, Chicago. This is a comparatively new company with excellent prospects. They make a specialty of rewinding and repairing electric machinery, also of dynamo and motor inspection.

MR. J. B. GRIER, of the Keystone Chemical Company, Chicago, showed some interesting experiments and results of the use of their compound tri-sodium phosphate for preventing the formation of scale in boilers.

THE CUMMINGS AND ENGLEMAN CONDUIT COMPANY, of Detroit, were represented by Mr. E. M. Engleman who showed sections of their different underground systems for railway power transmission and lighting purposes.

Mr. W. C. Gotshall, General Superintendent of the Citizens' Street Railway, of Muncie, Ind., was an interested visitor aiming to keep abreast of the times in securing knowledge of all the new an interesting things in railway work.

THE EUREKA TEMPERED COPPER COMPANY were represented by their General Sales Agent, Mr. J. R. Coffman, who showed a full line of these popular goods; also the Eureka brush holder. These goods are now in universal use.

CHAS. A. SCHIEREN & CO., was represented by Mr. R. W. Grant, one of their general agents. A very tastful exhibit of this well-known concern's goods was on exhibition. Special attention was given to their perforated electric belting for railway generators.

THE UNITED COLUMBIAN ELECTRIC CO., who are now building the "twin" Winkler street railway motor, were represented by Mr. H. W. Weller, the new general manager of the company. The apparent advantages of combining two motors in one piece of mechanism were the subject of much discussion among the delegates.

THE PAIGE IRON WORKS, of Chicago, specialists in the manufacture of all kinds of rails and track work for cable and electric railway, had a large exhibit in the Exposition hall. A special removable guard rail was a feature that received a great deal of attention. Mr. A. W. Paige, president, was personally in charge.

WHAT looked like a huge cake of toothsome Vermont maple sugar proved upon inspection to be a mass of Kent's motor lubricant (grease). This grease is all lubricant. It does not get hard in cold weather and requires a heat of 350 degrees to melt it. Mr. H. W. Kent was in charge of a splendid exhibit of these products.

THE GIBBS ELECTRIC CO., of Milwaukee, were represented by Mr. L. T. Gibbs, vice-president and secretary of the company, showing their overhead material. This company make a specialty of trolley poles and all interchangeable parts thereof; also intermediate armature and gear bearings for all standard makes of machines.

THE HOPE ELECTRIC APPLIANCE COMPANY, Providence, R. I., showed a bi-polar cut-out, which is instantaneous in its action and is made for the fuses on the outside. The Railway Equipment Company are Western sAgents for the company. Mr. Wright representing the company direct was also in attendance at the convention.

MR. FRANK A. MAGEE was again on hand in the interest of The E. S. Greely & Co., of New York. He had some samples in his pocket, but that was enough; their goods are so well known as not to require a sample trunk along at all times. Fortunate delegates were those who received one of their handsome souvenir match safes, bearing the name of the house.

MR. M. D. LAW represented the Love Electric Traction Co., of Chicago and Washington, and had with him some very pithy literature on the subject of the Love conduit system now under test in both cities. This conduit has advanced from its early experimental stages into that of practice, and bids fair soon to be in extensive use. A report of the discussion on this subject in the convention appears elsewhere in this issue.

ELASTIC LOCK NUT.—One thing that came in for a share of admiration was the Elastic Lock Nut, made by the National Elastic Nut Company, of Milwaukee. This nut is made of steel with a dove-tailed split on one side and is tapped slightly smaller than its bolt so that when it is wrenched on it opens about $\frac{1}{64}$ of an inch thus gripping the bolt firmly and remaining where left. This is a lock nut—not a "Nut-Lock."

MR. GARSON MEYERS, president and general manager of the Standard Railway Supply Company, of Chicago, was assisted by Mr. Walter McDonald in showing their excellent line of overhead material, stones, steel repetition gongs, swivel trolley yokes, etc. The office of the company is in the Monadnock Block, Chicago.

EDISON MANUFACTURING CO.—The exhibit of the Edison Manufacturing Co. was presided over by Mr. Jas. W. Gladstone, superintendent of the company. Edison-Lalande batteries were shown and especially the Kennelly electrostatic voltmeter, a full description of which was given in THE ELECTRICAL ENGINEER, of Oct. 18.

THE CONSOLIDATED CAR-HEATING COMPANY, of Albany, N. Y., showed a number of their street-car heaters with regulating switch attachment. Representatives of the company present were: Mr. J. F. McElroy, Consulting Engineer, Albany; Mr. H. M. Perry, General Western Agent, Chicago; Mr. H. N. Ransom, Agent, Albany, N. Y.

THE MICANITE CO., of New York, had one of the most interesting exhibits on the ground. They showed a very fine line of their products in motor and generator insulation, and it is needless to say that large numbers were attracted to the display, alike by its novelty and by its intrinsic merit. Mr. Jefferson was in charge, and had many opportunities of illustrating the great value of micanite as an accessory in street railway work.

THE MIAMISBURG ELECTRIC COMPANY, of Miamisburg, Ohio, showed a full line of samples of their goods, including finished commutators, etc., and all kinds of copper castings for electrical purposes, brush copper and brushes. They also showed their new "Imperial Dry Battery." Mr. A. L. Daniels, for years interested in the copper business, and Mr. D. H. Allan, general manager, were present in the interests of the company.

THE WESTINGHOUSE ELECTRIC AND MFG. CO. had large headquarters at the Hotel Pfister and a large staff, including Messrs. W. C. Clark, W. F. Zimmerman, B. F. Stewart, E. H. Heinrichs, W. S. Brown, Norman McCarty, E. W. T. Gray, T. H. Sanderson and others. They had some good literature to circulate and made a small though neat display of their railway specialties, including the car controller, rheostat, etc. Attention was naturally directed to the fine exhibit of street car apparatus at the World's Fair, by this Company.

H. W. JOHNS CO.—The interests of the H. W. Johns Co. were taken care of by Mr. W. F. D. Crane, Manager Electrical Department, Mr. H. A. Reeves, Chicago Rep., Mr. J. W. Perry, Philadelphia Rep., and Mr. E. B. Hatch of the Johns-Pratt Co. of Hartford, Conn. A complete exhibit of their molded mica trolley line insulators, and Giant strain insulators were shown for the first time at the Convention. Samples of tree insulators, molded mica waterproof sockets, Vulcabeston field and magnet spools controller pieces, bushings, etc., were also on view.

MR. W. R. GARTON, general manager and electrical engineer of the Garton-Daniels Electric Co., showed their improved automatic lightning arrester to many an interesting party. He frequently short circuited the entire plant furnishing the current for all the exhibits in the Convention Exhibition thereby showing the ability of the arrester to break the flow of current which follows the lightning discharge—this being done over 200 times without blowing a 15-ampere fuse. These goods are highly finished in burnished brass trimmings mounted on marble and slate backs, and in mahogany for all kinds of finely finished switchboards.

A. W. SLEE, St. Louis, agent for Wm. Wharton, Jr. & Co., of Philadelphia, exhibited a most interesting device termed an "Automatic Derailing Switch" for use at danger points, particularly railway crossings. When approaching a danger point the conductor must needs run ahead and insert a swinging bar in a hole or slot in a metal revolving disc in the centre of the railway track and flush with the roadbed, giving it a half turn and allowing his car to come along without danger of derailment. Failure on the part of the conductor to do this means the derailment of his car positively, as the switch sets itself for derailment automatically immediately the car has passed over it.

THE CURTIS ELECTRIC MANUFACTURING CO., were represented by Mr. C. G. Curtis, president, and Mr. D. D. Book, electrical engineer. A complete motor car equipment was shown in the Exposition Building, in full operation. It comprised the regular two motors of the standard Curtis "Box" type, already described fully in THE ELECTRICAL ENGINEER, and the series-multiple platform controller, which is at once the handiest and most effective of its class that has appeared in a long time. It is a controller that the greenest motorman can use with safety, and exhibits a remarkable freedom from arcing at the contacts. The handle may also be turned to any position and left without risk of burning the contacts. It is also noteworthy that the reversing switch is contained within the controller case, so that all connections are led up to that point, where they can be seen and got at if need be. The whole apparatus was in incessant test during the two days, and the enterprise of Mr. Curtis in setting up so elaborate an exhibit so far from home and in such excellent shape, was very highly appreciated by street railway men. No exhibit received more attention.

THE RAILWAY EQUIPMENT COMPANY, of Chicago, made an interesting exhibit in parlor 92, Plankinton Hotel. A full line of the type "G" overhead material was shown and samples were exhibited also of the new "Rail Bond Spring Bushing." This device was critically examined and approved by all who saw it. The concern was represented by President W. R. Mason, C. M. Corpening, and G. H. Van Vorhis. It may be mentioned that Mr. Mason has succeeded Mr. J. A. Corby just recently in the presidency, and thus resumes his old position.

THE J. G. BRILL CO. were represented by John Brill, vice-president, P. S. Corwin, Western agent, P. K. Andrews, Chicago, W. H. Huelings, secy., Walter Adams, M. E., F. C. Randall, Eastern agent, N. Y., showing their 22 foot double-truck car; also their 18 foot car with No. 21 truck. A special exhibit was made of their double-decked 18 foot car in commission between the Convention Hall and hotels. In Exposition Hall was shown their No. 21 Eureka maximum traction truck and No. 25 truck, improved track scraper, and a vestibuled end of street car showing patent folding door safety gate, gong, lever brake, ratchet brake, sand box, etc.

THE PENNSYLVANIA STEEL CO. (No. 2 Wall street, New York), were well represented by Messrs. Ostrom and Pratt, who, in spite of the late arrival of their specimens, made a most striking and interesting exhibit of their rails, turn outs, steam railway cross-overs, etc. As many of our readers are aware, this company has worked very hard at the problems of "deep rail" construction and their girder types are already entering largely into the best street railway work. Mr. Pratt, the designer has produced many remarkable sections combining beauty and strength. Nine inch rail, with 12-bolt fish plates, must make many an old railway man stand aghast, yet when we consider the requirements of city paving, the heavy loads carried by heavy cars, and the saving in wear of mechanism that a massive track affords, it must be confessed that the company are "on the right track." Mr. John Seely, who has recently put in some of this fine rail at Cleveland, informs the writer that it has proved most satisfactory. The company has, moreover, rolled deeper rail than this, for New Orleans.

LEWIS & FOWLER CO.—A full contingent of jovial representatives of the Lewis & Fowler Co. of Brooklyn were present. A convention without their usual little receptions and entertainments would not be a convention at all. These little "times" leave a pleasant spot in the memory of all who have visited the street railway conventions for years past.

THE WESTINGHOUSE exhibit in Exposition hall was well worthy the attention it received from visiting railway men, desiring better car equipment and high grade rails, and in addition there was one table set apart for the display of the latest Westinghouse literature, a conspicuous pamphlet being a collection of testimonials from the users of the Westinghouse railway apparatus. The company had also an outside exhibit in the shape of several new cars equipped with the single reduction motor and the latest controlling devices. Among the gentlemen at the convention were, Mr. L. Bannister, W. F. Zimmermann, W. C. Clark, B. F. Stewart, C. A. Bragg, W. S. Brown, G. O. Fairbanks, W. J. Longmore, E. H. Heinrichs, J. A. Rutherford, E. W. T. Gray, T. W. Burrowes, Maurice Coster, Norman McCarthy, Guido Pantaleoni, G. H. Sanderson, T. F. Allen, Albert Schmid.

THE GENERAL ELECTRIC COMPANY made a very fine and practical exhibit of street railway motors and supplies at the Street Railway Convention. Its principal exhibit, however, consisted of a working demonstration of the qualities of its new railway motor known as the G. E. 800, which has been described at length and illustrated in our columns. Street railway managers had an opportunity of verifying its claims to extreme lightness, ease of control, accessibility, compactness and the noiseless way in which it works. They were also able to witness its lightness upon the track, and compare the advantages of the new method of suspension which has just been introduced and which we described in a recent issue. With this motor was shown the new General Electric series parallel controller known as type "K," which comprises within itself all the necessary controlling movements. The case contains, besides the regulating device, the connection board, the motor cut-out switches and the reversing switches. Its introduction does away with moving parts beneath the car, and, being provided with a magnetic blow-out, arcing is prevented. By means of an interlocking device between the reversing switch and controller the operation of either, unless in proper position relative to the other is impossible. The combination of the new motor and new controller is affirmed to be the most economical step toward perfection in electric railroading made since the last Convention.

In addition, a special and effective display was made of a complete new line of overhead line apparatus, which was brought out, for the first time, at this Convention. In devising the different appliances especial care has been expended in meeting all the requirements of the most arduous railway service. The insulating compound used is known as the "L" compound. Its insulating qualities are higher than has been heretofore obtained, and its peculiar composition and the pressure to which it is subjected render it most suitable for the purpose for which it is employed. While departing to some extent from the usual forms which have obtained in street railway practice, no modification in form has been made without a proportionate gain being effected.

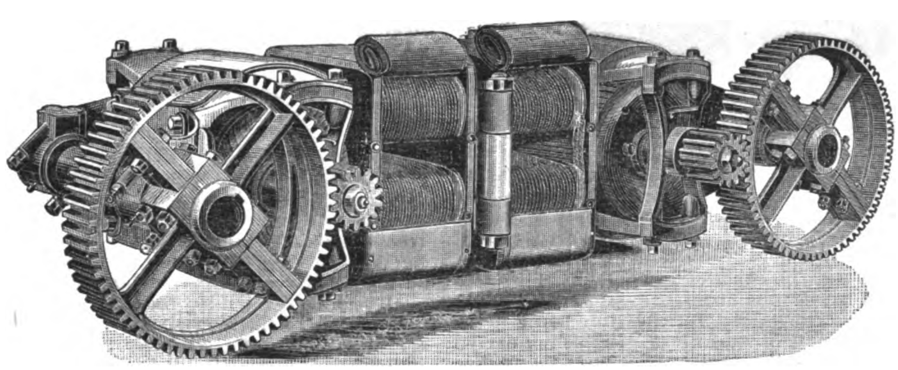
The General Electric Company also had two cars in service on the Milwaukee lines. One a Brill car and truck fully equipped with two G. E. 800 motors and type "K" controllors, and the other a Brill double-decked car also equipped with two G. E. 800 motors and type "K" controllers. The double-decked car is a handsome piece of car building and electrical equipment. Furthermore, there were one McGuire truck, and one Peckham truck, each equipped with motors and controllers as in the case of the Brill cars, and one Lewis & Fowler car on a Peckham truck similarly equipped. The three last named equipments were shown in the Exhibition Hall.

Street Railway men were cordially invited to ride on the two cars in service, for which passes were given at the General Electric Headquarters at the Convention, which were located at the Pfister Hotel on the second floor, where elegant parlors had been secured, and where all railroad men were made welcome.

The interests of the General Electric Company at the Convention were in the care of Mr. Theo. P. Bailey, of the Chicago office, assisted by Mr. G. K. Wheeler, Mr. G. Atterbury, and others from the same office. Mr. O. T. Crosby, Mr. Theodore Stebbins, and Mr. R. H. Beach, were present from the main office in New York, Mr. W. J Clark from the Cincinnati office, Dr. T. Addison from the San Francisco office. The engineering representatives were Mr. W. H. Knight, Mr. J. B. Blood, and Mr. A. K. Baylor.

THE WINKLER TWIN SERIES RAILWAY MOTOR.

MR. CHARLES F. WINKLER some of whose inventions in dynamos and motors have already been described in THE ELECTRICAL ENGINEER, has recently designed a type of railway motor which embodies a number of decidedly novel features.



WINKLER TWIN SERIES RAILWAY MOTOR.

The motor, which is illustrated in the accompanying engraving, has two armatures but only one magnetic circuit. These two armatures are connected by single reduction gear to the two axles of the car; to all intents and purposes it is a single machine, and yet mechanically it embraces two distinct motors. By this arrangement it is claimed that the weight of a given electrical output is greatly reduced.

In operating the Winkler motor in street car service, the same plan may be used as if two distinct and separate motors were employed; either armature may be cut out when desired. When climbing grades, heavily loaded, or hauling a trailer, the two armatures are operated in series, and when great speed is desired they may be placed in multiple. If running on a level track and only a moderate amount of power is needed, either armature may be cut out and the car operated by a single armature.

A single magnetic circuit makes practicable the permanent coupling of two armatures in series, for the action of the magnetic lines of force on the two armatures is then identical. This fact compels the two armatures to work in harmony with each other under normal conditions, a result not always obtainable when two separate motors with two separate magnetic circuits are operated in series. It is well known that two motors operated in series with each other are more efficient and can be operated more economically than otherwise, because the counter-E. M. F. can be obtained with one-half the number of turns of wire on each armature, which means only about one-half the resistance.

The distinctive characteristic of the motor, however, is the flexible joint at the centre of the field magnets. Although the machine is directly supported by strong bronze yokes on the car axles and all centre supports are dispensed with, the motor does not possess a rigid or stiff frame, but is provided with an ingenious flexible joint consisting of two sliding contacts midway in the field and held together by a coupling ring, as shown in the illustration. It is asserted that this peculiar construction of the field magnet does not in any way affect the magnetic circuit. Its use in a double motor for street car service adapts the motion of the motor to the curves and defects in the track. The field magnet cores are made of the best cast steel.

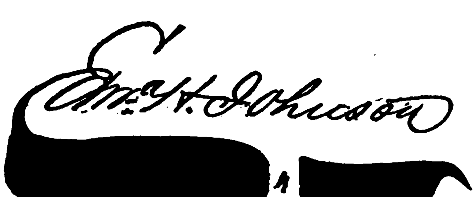
The armatures are what may be called the "iron clad" type, the wires being imbedded in the cores in such a way that the winding is carefully protected. Heavy moulded mica insulation is used. The field coils are wound on separate spools and all parts of the motor are interchangeable and easily accessible, so that the motor may be taken apart or an armature removed very easily. The gears and pinions are cut of cast steel and encased.

The total weight of the motor complete is 4,200 pounds, and its rated capacity 50 h. p. A speed of 18 miles an hour is easily obtainable with 30-inch wheels. In actual work it has carried in 6¼ minutes 35 passengers up a grade 1¼ miles long with a total lift of 440 feet, with 17 sharp curves and some grades as steep as 10 or 12 per cent.

The new motor is built by the United Columbian Electric Company, whose factory, at Kingston, N. Y., is under the personal supervision of Mr. Winkler. The offices of the company are in New York, and are in charge of Mr. H. W. Weller, general manager, who brings to his aid a long and varied experience in electric railway work.

ELECTRIC CAR CONTROL.

BY



A GOOD work well begun is finished easily "on the run." The ENGINEER'S discussion of the trolley's short-comings, is, if we are to judge by the extraordinary contributions thereto, appearing as they do on the instant and in such intelligent form, destined to effect a quick and satisfactory solution of what had come to appear an almost unsolvable problem. This is not infrequently the case as is well attested by the writer's own experience. He does not hesitate to assert that he has accomplished much in the way of evolving valuable inventions from the minds of the inventive talent with which he happened for the time being to be associated, by the simple process of stating the problem clearly, freeing it as it were from the haze of immaterial matter and disclosing the specific desideratum.

Edison, Sprague, Bergmann and Lundell will cheerfully confirm this thesis. It thus happens that we pass from the chaotic thrashing of the subject in hand by the daily press through the clear statement of the subject by the ENGINEER to the reponsive touch of the professional doctors. Let us review these last as they appear in a single issue of your valuable paper.

Take Doctor Lain ; he sings a peon of praise by way of a salve to his professional pride and then proceeds to diagnose the case. He finds greater inertia and greater momentum than in the "horse" state but does not find its antidote of safe restraining power He asserts the presence of ample energy but admits its fleeting and unreliable character. He then proceeds to apply the remedy and herein we shall find much disagreement among the doctors as to specific formulas. Dr. Lain would provide the patient with additional mechanism, "air brakes" with actuating motors independent of the suffering principal. We can hardly accept this method of treatment since it imposes additional strains and complexities, whereas, we must aim to lighten and to simplify ; but his views clear the case somewhat and for this his meed of praise should be paid.

Dr. Shepardson steps in and analyzes the matter in a kindly spirit ; he thinks the family have exercised a proper degree of care and thoughtfulness, but is also compelled to admit the presence of a disease and observing the same symtoms he proceeds to prescribe remedies. They are multifarious. He would improve the patient's surroundings, slightly alter routine, and, like Dr. Lain, would superimpose another body whose independent function would be to act as a guard or nurse. We shall likewise have to pass this doctor by as too complex in his methods.

Dr. Field starts out in a rather drastic manner: he denies at the outset an indifference to the effect of the disease upon the community at large, but, nevertheless, tells them to move on or take the consequences. In giving this warning advice he seems to feel that he has performed a sort of "extra voluntary," whereupon he proceeds to remedies. He cannot, however, refrain from telling the patient he is well enough, though he illogically admits the presence of disease. He, too, would provide a supplemental body capable of restraining the patient, however violent. He has a glimmering ray of light in the right direction, but abandons it without sufficient examination, finally deciding simply to coddle and surround the patient with additional nurses and guards.

Dr. Whetherford though finding the disease virulent, recognizes the presence of great inherent vitality, suspects from certain personal experiences that a radical cure might be had by a scientific utilization of this inherent energy, but, professing no special training, leaves the matter to qualified experts and passes on—doubtless modestly assuming that he contributed nothing of importance; yet, as we shall presently see, his is the voice we should heed.

Dr. F. has a medicine which will cure all the ills the patient is heir to, as well as many we know not of, but he is not just ready to prescribe it. He is, however, sanguine that as soon as it is compounded and ready for the market, its virtues will be instantaneously recognized. Let us wish him well but not stay our search for available remedies.

Dr. Wilkes concludes that inasmuch as the patient has incurred the malady from running down hill too fast, the remedy is to so strengthen that the run up hill can be made faster than has been the practice and thus avoid the necessity for such down hill speed, and its consequent ills. Dr. Wilkes evidently overlooks the stubborn fact that, get up hill as quick as may he, the patient will in this great American atmosphere, go down the hill none the slower. The patient's great capital is time, and to make the best interest thereon despite all authorities, is the goal always in view.

Dr. Walcott talks philosophically for a few moments and then, asserting that the patient is not ill at all, passes hurriedly on to catch a train. The sage has spoken and is complacently content with a duty well done.

Dr. S. would provide the ordinary nurses and guards to keep the patient from too violently exercising his athletic fancy. His views are not radical, in fact, are so conservative as to suggest the wonder how he came to express them at all. Several other eminent experts contribute their advice and opinions, all are however of the same general tenor and effect.

Now, let us try and get on common ground with these doctors and see whether, or no, our pessimistic forecast is justified. Have we in fact made good progress in discovering a true remedy, or have these disagreeing doctors left us more hopelessly at sea than before?

1st. We have a practical consensus of opinion that the patient is suffering from ills which render him insubordinate to control. His general health is good, his vitality is extraordinary. He is capable of unlimited work and, under ordinary conditions, is tractable enough, but in moments of excitement gets absolutely beyond the pale of ordinary restraint.

2d. We have an infinite variety of specific nostrums prescribed —all however, intended for external application, whereas, the disorder being of the nerves, and therefore of the brain, demands internal remedies of a soothing character rather than the external irritants suggested.

These two fundamental premises being admitted, is not the doctor present who can treat the disease effectively ? I am convinced he is and now invite through your columns suggestions as to the control of an electric car *by means of the motor alone*, employing the ordinary brake equipment only as an emergency device, in fact, reversing the present unsatisfactory practice.

"TROLLEY ACCIDENTS."

I HAVE read with interest the articles of Mr. E. H. Johnson and others, relative to efficient brakes on trolley cars. Of course, it is evident, that the sudden reversal of the motor would result in the destruction of the gear. And besides, the worst possible method of stopping a car is to slide the wheels. The result is always to "flat" the wheels and ruin them.

Why not apply the current in another way? Hang between the wheels on each side, over the rails, a coarse wire coil, with the core in guides, and capable of perpendicular movement. Put a cast iron shoe on the bottom end of the core, within two inches of

the rail and parallel with it. Let the upper end of the core project above the coil, through the upper guide plate. Above the guide plate put a spiral spring around the core, held by a head on the core. This spring will hold the core up in place, off from the rails.

A treadle on the foot board conveniently placed, with top and bottom connections, will complete the outfit. The current from the trolley connects with the treadle switch. Normally, the switch is in contact with the upper stop which connects with the brake. The bottom stop connects with the brake coils. To stop his car quickly, the motorman does not "shut off" at all. With his foot, he presses down the treadle, throwing the entire current through the brake coils. The rails act as armatures, and the brake shoes are drawn strongly on the track, stopping the car *at once* if the pressure on the treadle is continued. I give this advice gratuitously as no patent can be obtained upon it An English patent for a brake to be applied to steam road cars was issued many years ago, the source of power being current from a battery to be carried on the car. It was an awkwardly contrived affair and never came into use; but it contained the germ of the above plan, as I discovered when searching the records.

Is not the suggestion worthy of trial?

C. H. HASKINS.

NEW YORK, Oct. 16, 1893.

SINCE the days of Stephenson when at the opening of the Manchester and Liverpool Road his celebrated locomotive, the "Rocket," run down a prominent member of the Iron Duke's cabinet, there have been arguments for and against rapid transit. In this particular case some writers were horrified at the dangers of such a project, while others could see immense advantageous possibilities in a system that was capable of carrying the injured man a distance of 17 miles in 25 minutes. Those same old considerations confront us to-day. The issues have not changed one particle since that memorable September day in 1830 when the first railway accident occurred. Although after desperate resistance in many localities (thanks to the trolley system) rapid transit has won the fight, the enemy is not silenced and should not be until this and all other methods of transportation are surrounded by every safeguard that human ingenuity can devise. At the present writing, on portions of the routes in every city in this country, the patrons of the trolley roads demand a three-minute gait. The ordinary electric car has the ability to respond. Its control is often in the hands or an overworked man who is sometimes not alert. The bad results are frequently loudly chronicled under the heading of your recent editorial, *i. e.*, "TROLLEY ACCIDENTS." The experience on steam roads where the track is level and clean and the stops infrequent has demonstrated that a run of 100 miles per day is as much as locomotive engineers can stand. This average standard is commonly followed in electric railway practice where the conditions are entirely different and much more severe. Under such circumstances when we consider that at the three-minute gait referred to the car is moving its full length each second, it is highly important that the motorman be under mental strain ready to act instantly.

Usually the motor cars are unnecessarily heavy. In a communication to THE ELECTRICAL ENGINEER (April 5th, 1893) I referred to this and the following subjects from an economic standpoint. The same reasoning may bear repeating where the subject of safety is considered. In the construction of cars the controlling factor lies in the roof. To get a durable construction, all of the other parts must correspond in stability and weight. If an omnibus top be substituted for the ordinary heavy "Monitor" pattern the balance of the entire structure may be correspondingly lightened and more easily controlled. All street cars should be provided with track brakes. With them one can readily get the adhesion of twenty inches of surface between the car and the rails where, in the ordinary system, much less than one inch is depended upon, *i. e.*, only that between the wheels and track.

Ordinarily it takes nearly as much power to stop the heavy high speed armatures as it does the balance of the car. It must be clear that with constant running armatures the cars can be more easily controlled. I am an advocate of those appliances. I have used them in daily practice for a period covering several years. They are capable of economical operation and I can recommend them to all as life savers.

JOHN C. HENRY.

WESTFIELD, N. J., Oct. 10, 1893.

FROM the standpoint of an outsider, it would seem as if the discussion of the problem, "To provide more effective braking power for trolley cars," lay in the application of force to the wheels of the moving car to prevent their turning, and so causing the car to slide along the track until brought to a stop. The frictional contact of the wheels with the rails is very small, in fact, a minimum, and changing a rolling contact into a sliding or frictional one at the wheels, would seem to be power thrown away. Why not, then, turn the attention to a different application of the brakes, relieving the wheels and axles of the straining twists of the old fashioned brakes, and let the weight of the entire car become the frictional power?

If a pair of shoes approximating a rail surface in width, and governed in length by the distance between the front and rear axles of the car (with proper clearance for the wheels) be suspended from the car frame on each side, and movable perpendicularly for a space of a few inches, then, if upon the application of the proper power these shoes were forced down upon the rails, in fact, operating as a lift to the entire car, it is easily seen that an immense frictional contact is at once exerted, and the car will be stopped in short order.

As to the application of the power to produce this contact with the rails, various methods suggest themselves of which those most prominent appear to be the use of compressed air, a modified vacuum brake, or the use of the current while reversing the motors in case of emergency.

The application of compressed air stored in a reservoir on the under side of the car body supplied by a pump working from the car axle while in motion, and released at the proper moment by the motorman, either from the brake handle as now applied, or by a separate controlling movement forcing a piston against a toggle joint connected with the brake frame, would exert much greater force, operating in a manner calculated to produce more effective results than a one man power at the brake handle, although he exert the strength of a dime museum Samson.

For the vacuum brake, the power would be applied in the same manner, assisted by springs similar to those in present use on railway trains, but employing the vacuum to hold the brake shoes away from the rail against the expansive force of the springs and having the tendency to force the shoes downward. The electric current from the reversed motor would be applicable through a shunt to a small auxiliary motor as the reversal lever came to a certain operative point in reversing, switching in more current to the brake motor the further the lever was reversed.

As far as I am at present aware, these applications of power have never yet been utilized for this particular purpose, and these suggestions are given for the purpose of assisting in THE ELECTRICAL ENGINEER discussion of the best means of controlling the car. Taken in a mechanical sense, they may be, and probably are, defective, but American ingenuity can overcome such obstacles if the principles involved be sound.

RUFUS B. CRISSEY.

TROY, N. Y. Oct. 16, 1893.

SINCE reading your timely editorial of Sept. 27, I have given the question of electric car braking quite a little thought and have come to the conclusion that for an "emergency" brake at least, a series of one or more powerful electromagnets could be placed between the wheels of the trucks, the pole-pieces being made to follow the contour of the track, as much as practicable, thereby giving a larger and more powerful "gripping" surface. These pole-pieces should be placed as near as possible to the track, consistent with the motion of the car and the current for the magnets taken from the circuit before reaching the motor switch (a means could readily be devised whereby in throwing out the motors the electromagnets could be switched in.) With the ordinary brake of to-day the wheels, if gripped too tightly, "skid," and the car slides forward, instead of stopping at once.

With the electromagnetic brake, a very powerful attractive force can be exerted between the rail and the car, tending to stop the latter; this it appears to me is a much better scheme than the so-called "Track Brake" which tends to rack the car by reason of its *sudden* method of application, whereas in the "magnetic" brake the force is exerted without so much wear and tear on the car and its mechanism. Mr. W. E. Harrington in the Oct. 18 issue of your paper, seems to have hit upon the same idea, for he says, braking should be accomplished "by means of some outside mechanical, electrical or magnetic positive connection between car and rail.

J. R PITMAN.

FRANKFORD ARSENAL, PHILADELPHIA, PA., Oct. 19, 1893.

I RECOGNIZE, as do others, that the high rate of speed at which electric motor cars are now run makes the adoption of a quick action brake an absolute necessity. Another point to which attention should be drawn is the location of the guards to the wheels. On many cars these guards are placed so high from the rail that they do not serve the purpose for which they are intended. With the present improved roadways there seems to be no valid excuse for placing the guards so high and for not having some form of wire guard at each end of the car.

With an efficient braking apparatus, properly placed guards, and a cool-headed, experienced motorman, there is every reason to expect a material lessening of the number of accidents due to the so called "deadly trolley."

F. E. IDELL.

NEW YORK CITY.

STREET CAR MAGNETIC CUT-OUTS.[1]

BY W. E. HARRINGTON.

THE definition of magnetic cut-out is a cut-out which opens the circuit instantly at a set strength of current. The magnetic cut-outs most familiar are those used on switchboards in power stations, and embody in all instances the long throw switch to break the violent arcing which always ensues on the breaking of the circuit. Carbon points are sometimes used to take the final and most destructive sparking. On all the forms of cut-outs as above described, considerable care and repeated cleaning of the switch is required, owing to burning of little fused teats on the knife blade or jaws of the switch. The switch also occupies considerable space, as well as being quite expensive. All these reasons militate seriously against the use of such magnetic cut-outs on local car or motor circuits.

The only protection used now on our local car or motor circuits is a fuse. The definition of a fuse by fuse manufacturers is: "Fuse wire is a safety device designed to break the electric circuit when an excessive current passes, and it breaks the circuit because it is heated to a temperature at which it melts. The fusion necessarily depends upon all the elements that affect this heating, and it takes time to heat even a wire. . . ."

A fuse has another property, which has never received the serious attention that its importance demands, to-wit: the passing of currents momentarily far in excess of its rated fusing or blowing capacity. It is in this latter property that we have all suffered at times—which in our power station work peremptorily demanded the abolishing of the fuse cut-out. And if the magnetic cut-outs as used to-day could have been adapted from both the practical and cost standpoint to car work we would be over the occasional and vexatious troubles incidents to street-car propulsion by reason of unreliability of the fuse.

To illustrate what is meant by our statement of unreliability of the fuse, the ordinary street car of to-day will take current sometimes as high as 100 amperes, but with an average current of about 25 amperes. The usual custom is to place a 50-ampere fuse in the motor circuit for its protection. Now what results if a wire, coil, armature or any part of the motor circuit is grounded or shortcircuited with a consequent abnormal rush of current? In practically every instance *momentarily* the fuse will carry 2-3-400 amperes without blowing; but with the result of opening the magnetic cut-out at the power station, controlling the division on which the disabled car is; this naturally affects every car on that division. This trouble continues until the disabled car is found and removed from the service. Whereas, if a simple, cheap, reliable magnetic cut-out were placed on the car, the opening of the magnetic cut-out at the power station, as described above, would not have occurred, as the local car circuit itself would have been opened.

The petty troubles arising occasionally on local car circuits are of such a character that we are as liable to their repetition as we are to the occasional hot-crank pin on our engines—we cannot prevent insulation from failing, wires from breaking, or careless employees leaving car brakes set. These are troubles we will always be subject to, no matter how careful may be the design and manufacture of our apparatus. It is therefore exceedingly important that as our systems are increased, our lines extended, that this weak and most exasperating of all defects, the stoppage and crippling of an entire line or division, by reason of failure of a single motor equipment, should be remedied by confining the stoppage to the immediate unit or car. Another trouble of serious importance is the possibility of fire, the burning and damaging of cars by reason of fire. Many cases of fire in cars, due entirely to insufficient protection, have been recorded during the last few years.

It has been urged that a magnetic cut-out is too sensitive, and this sluggishness of the fuse is desired for street car work. This is admitted as far as the regular range of variation is concerned. For instance, you know that on your road, with your cars, the extreme maximum limit of current ever momentarily used is, say, 100 amperes. Then set your magnetic out-put to open on the passage of 125 amperes. Your fuse does not protect, although rated at 50 and will momentarily carry 400 amperes, whereas the maximum increase on your local car circuit, with the magnetic output, cannot exceed 125 amperes.

It has been raised as an objection that a magnetic cut-out is not a necessity—that the failures on local car circuits are so seldom that we do not need it. I think if every railway manager will recall the occassional interruptions on one or more of his different divisions, with the report handed to him that cars cannot be run owing to there being trouble on that division, which has to be hunted for and removed, he will agree to class the magnetic cut-out among those other safety devices such as lightning arresters, safety valves, etc.

The magnetic cut-out which is herein referred to, differs radically from all other types of cut-outs, and it is in this radical difference wherein the cut-out is cheapened and adapted to street car work. There is no heavy, long throw switch and there is no arcing, absolutely none, at the main switch when it opens, as all the energy and what would otherwise be destructive sparking, is dissipated in an exterior hermetically sealed chamber. This cut-out which is my invention has been in practical operation for the last few years fully demonstrating its scope and usefulness.

1. A Paper read before the American Street Railway Association, Milwaukee, Oct. 19, 1893.

SOCIETY AND CLUB NOTES.

MONTHLY MEETINGS OF THE INSTITUTE—THEIR ORIGIN AND PROPOSED DEVELOPMENT.

AT the meeting of the American Institute of Electrical Engineers, held on October 18, the secretary, Mr. R. W. Pope, read a paper on the above subject, in which he gave a history of the movement and the plans which had been proposed for holding meetings in places outside of New York. One of the plans proposed in the paper was that at those points where the various sections are to meet, and the author is not present, the member selected to present the paper, should be provided with an early proof so that he may be prepared to reply to any questions that may arise. These sectional meetings might be presided over by regularly elected members of the Council, or a temporary chairman; either course being available. The details of arrangement for such meetings would necessarily be in the hands of a local committee or secretary. Notes of the discussion could be taken by the secretary, and afterwards written out in full by the speakers, or a verbatim report could be made if the necessary expense was provided for. In any case the report of the discussion might be sent to the secretary, and revised by the Editing Committee.

In the discussion which followed the reading of the paper Dr. Charles E. Emery submitted a plan elaborated by him by which some of the difficulties and objections to the carrying out of such a system might be obviated.

On motion of Mr. H. Laws Webb the whole matter of local meetings was referred to a committee of the Council to report upon at an early date.

NEW YORK ELECTRICAL SOCIETY.

THE 153d meeting of the N. Y. E. S. will be held at Columbia College on Tuesday, Oct. 31, at 8 p. m. Mr. D. McFarlan Moore will lecture on Electricity in Advertising, and will describe the most recent developments in this branch of electrical application.

COLLEGE NOTES.

THE YOUNG MEN'S INSTITUTE.

THE evening educational classes of the Young Men's Institute, No. 222 Bowery, have a larger enrollment than in any previous year in the history of the Institution. Over 40 are taking the course in Steam Engineering, 35 in the class in Electricity, 40 in Bookkeeping; altogether 300 young men, who are working in the day time, here employ their evenings seeking mental improvement. Special attention is given to technical studies and the membership is largely made up of young mechanics.

On Tuesday, Oct. 24, Prof. F. B. Crocker delivered a lecture at the Institute entitled, " What Electricity Can Do."

THE TELEGRAPH, THE TELEPHONE AND THE STORM.

THE storm that raged along the Atlantic coast on the night of Oct. 13 was, with the single exception of the blizzard of 1888, the most disastrous with which the telegraph companies have ever had to deal, as it swept all around taking wires down everywhere. New York was practically cut off from every part of the country except the New Jersey coast and Connecticut. There were still some wires to Buffalo and Philadelphia, but little or nothing beyond. Every man who could climb a pole or splice a wire was put to work the next morning and by night the companies had re-established communication with every place of consequence in the country except Charleston.

Most of the United Press news from New York to Chicago was sent by a combination of the telegraph and Long Distance telephone service. A telegraph operator sent the matter through from New York to Pittsburgh. There a telephone transmitter was hung over the Morse instrument and the other end of the wire ended in an earpiece in the United Press office in Chicago. Two expert operators took turns at receiving, holding the ear piece up with one hand and writing with the other. They declared that they heard the clicking of the instrument in Pittsburgh as distinctly as if the machine was only six inches from them. The excellence of the service can be imagined when it is said that 3,000 words were received without a break. The Long Distance telephone wires were used last fall to send out the reports of the Yale-Harvard football game at Springfield, Mass., but telegraph instruments were attached to both ends of the wire in that case.

PERSONAL.

HENRY WRAY WELLER, C. E., E. E.

Henry Wray Weller.

THE fact that Mr. H. W. Weller has taken the general management of the United Columbian Electric Co., manufacturing the Winkler "twin" motor for street railway work, is one of interest to a large circle of friends. Mr. Weller was born in London, England, in 1858, and some of his earliest professional work as an engineer was done for the Midland Railway. He then spent six years with Coke & Mills, mining and civil engineers to the Duke of Devonshire and the Duke of Rutland. After this he was engaged as assistant mining engineer at Sir Joseph Pease's collieries, near Darlington. His first visit to this country was then made, when he came in the capacity of a mechanical engineering expert to report on various patents for an influential London syndicate. On his return home, he was appointed chief assistant engineer under Mr. R. Vawser, on the Manchester, Bury and Rochdale Steam Tramways, the Barrow-in-Furness tramways and other public works. From 1885 to 1889, he held the post of public engineer to the Chesterfield Union district.

His American experience had, however, led Mr. Weller to watch developments here, and coming back in the early stages of practical electric railway development he became connected with the Sprague Electric Railway & Motor Co., as one of its staff of experts. That his ability was appreciated was shown in the fact that after the Sprague and Edison consolidation, he became assistant manager of the Railway Department. Through the various subsequent consolidations and internal changes of the kaleidoscopic General Electric Co., Mr. Weller has held on quietly and steadily, in the department of railway work, and of late his energies had been very successfully directed to the building up of the railway supply branch of the company. This, however, did not afford scope for his engineering and executive qualities, and led to the important change of work referred to at the opening of this sketch. The Winkler motor in his hands will now be actively promoted and, we believe, installed quite generally.

Mr. Weller, it may be added, has been for many years an associate member of the English Institution of Civil Engineers and is a member of the American Institute of Electrical Engineers.

MR. JAMES A. ROBERTS.

MR. JAMES A. ROBERTS, who has been nominated on the New York Republican state ticket for Comptroller, is secretary of the Buffalo General Electric Company and one of the founders of the old Thomson-Houston Company, of that city. He is also vice-president of the Buffalo and Bellevue Street Railway Company, and of the Niagara Falls Electric Light and Power Co. Mr. Roberts represented Erie County in the New York Senate and Assembly some years ago. He came to Buffalo from New England as principal of one of the city schools. In addition to his many other qualifications and unquestioned probity, Mr. Roberts is also well versed in the law, to which he has devoted considerable study. With the constantly increasing legislation affecting the distribution of electricity, a man of Mr. Roberts' knowledge and experience in electrical matters ought to be a valuable addition to the state government, and he will, we hope, receive the support of all interested in electrical matters.

MR. CHARLES A. SCHIEREN.

MR. CHARLES A. SCHIEREN, widely known to electrical people and the manufacturing public as the manufacturer of dynamo and power transmitting leather belting, has accepted the Republican nomination for the Mayoralty of Brooklyn, N. Y. Mr. Schieren has opened headquarters and is actively engaged in the work of the campaign. Mr. Schieren has our best wishes for his success.

PROF. H. L. CALLENDAR, Fellow of Trinity College, Cambridge, England, has been called to the chair of Physics at McGill University, Montreal, which has been recently endowed by W. C. McDonald, Esq. Prof. Callendar, though a young man, has already a brilliant record for original work in physics and is well qualified for the position he is to fill. He has devoted much time to research in thermometry, in which he is regarded as an authority, and has contributed a number of papers, chiefly on this subject, to the proceedings of the Royal Society, the *Philosophical Magazine* and other journals. Among other ingenious inventions, he has devised a method of compensating resistance coils for temperature errors and has invented an electric pyrometer which indicates fractions of degrees up to 3,000 degrees centigrade.

COL. GEORGE CANIC an intimate friend and countryman of Mr. Tesla has just left for home after a tour of the country extending as far as the Pacific coast, during which he devoted special attention to electrical matters at the Chicago Exhibition. Col. Canic occupies a prominent position in the Austrian Army, being attached to the General Staff.

PROF. VIOLLE left for France on Saturday, Oct. 22. He has made an extended tour through the country and regretted very much that his sojourn was curtailed for lack of time.

OBITUARY.

EDWARD BLAKE.

EDWARD BLAKE, whose sad death occurred at New Haven on Oct. 10, was born on November 3, 1862, and was graduated with honor in the class of 1884 in the scientific department of Yale University. He spent the year after graduation in the study of electricity in New Haven, and also the following year, at the Massachusetts Institute of Technology.

During a visit to Europe, in 1884, he made himself acquainted with the latest developments in his favorite science, and in 1885 he entered upon practical work in his chosen career in Boston, as representative there of the Sprague Motor Company with the most flattering prospects.

By request of the faculty of the Mass. Institute of Technology, he also lectured for several years before the students of that institution on electrical machinery, but was soon obliged to lay everything aside, and return to his home, where he died of consumption after years of lingering illness.

CAIRO—WHO WILL GET THERE FIRST?

THE following is from advance sheets of a Consular Report by Mr. F. C. Penfield, Agent and Consul-General, Cairo, Egypt:

"The Egyptian Government has decided to authorize the establishment of a system of tramways in Cairo and its environs. The introduction of tram lines would improve to a great extent the methods of transportation and communication in Cairo, and, if demonstrated a public convenience, a similar concession for Alexandria would doubtless be early decided upon. The matter is already attracting the attention of European capitalists and engineers, and it may safely be predicted that there will be some competition to secure the franchise. The permanent population of Cairo is roughly estimated at 500,000, of which 30,000 are Europeans. In the winter season the latter figures would be greatly augmented by the influx of travelers. Possibly the Department may deem this a matter of sufficient importance to be given to the press, for the benefit of Americans, who might wish to examine the feasibility of the enterprise with a view of competing for the concession. I venture the opinion that American electrical engineers could furnish a system of traction comparing favorably with any that will be submitted by Europeans. As stated in the official notice, bids will be received by the Minister of Public Works, Cairo, until the 1st of February, 1894."

Copies of the Official Notice of the Minister of Public Works, stating conditions on which concessions will be granted are on file in the State Department at Washington.

SIMPLY A NEW NAME.

THE electrical trade need have no misgivings as to the above. It refers to the Metropolitan Electric Company, formerly the Enterprise Electric Company. None of the "enterprise" of the old company is given up; on the contrary, additional capital and the name of Mr. W. H. McKinlock, added to the firm already well and favorably known to the trade, is satisfactory evidence that their intention is to make the Metropolitan Company a prominent one in the electrical supply field. The reorganized company will, in addition to carrying a full line of supplies, enter largely into the manufacture of these goods as well, particularly in everything pertaining to insulation. A flattering trade has been done right along by the Enterprise Company and with increased facilities much larger business is already being done.

The company's stores and offices are in the Manhattan Building, Dearborn street, Chicago.

MR. J. A. BROWN, of the Brown Dynamo Electric Telephone Co., of Moline, Ill., writes us denying the report that his company has been sued by the American Bell Telephone Co. He says that the report must refer to the Brown Telephone Co., of Chicago, which is an entirely different concern.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 10, 1893.

Alarms and Signals:—

Automatic Fire Alarm System, G. W. Brown, West Newbury, Mass., 506,584. Filed Sept. 1, 1893.
An electric thermostatic device for protecting buildings against fire.

Conductors, Conduits and Insulators:—

Moulding for Electrical Conductors, R. A. Fessenden, Pittsfield, Mass., 506,311. Filed Aug. 16, 1892.
Consists of a metallic sheath with one side removable and the interior filled or lined with fireproof insulating material provided with one or more grooves for the reception of the conductors.

Dynamos and Motors:—

Electric Motor, J. A. Davis and R. A. Fowden, Philadelphia, Pa., 506,208. Filed Dec. 23, 1892.
A step by step electric motor for controlling synchronously telegraphic printing and other instruments.
Electric Motor, J. A. Davis and R. A. Fowden, Philadelphia, Pa., 506,209. Filed Dec. 23, 1892.
A step by step motor for synchronously controlling clocks, telegraph, stock or type printing instruments.
Fan Motor, C. P. Elieson, New York, 506,481. Filed July 16, 1892.
A revoluble fan motor.
Regulator for Dynamos, W. H. Elkins, Cambridge, Mass., 506,482. Filed Feb. 27, 1893.
Consists of two brushes of like sign, the forward brush being connected directly with one terminal of the main circuit and the rear brush to the same terminal through a resistance coil.

Galvanic and Thermo-Electric Batteries:—

Electric Battery Cell, B. J. Wheelock, New York, 506,353. Filed Sept. 23, 1892.
Consists of a porous cup and a carbon element with a vertical and a horizontal portion, and a zinc element arranged upon the sides and under the bottom of the cup.

Lamps and Appurtenances:—

Carbon for Electric Arc Lamps, R. E. Ball, New York, 506,459. Filed Apr. 26, 1892.
A pair of carbons placed axially and one or both increasing in diameter from the arc end to the butt.
Electric Arc Lamp, C. Hoffmann, Berlin, Germany, 506,508. Filed Apl. 5, 1893.
The invention consists in a differentially-acting arc-forming and carbon-regulating magnet and in a short circuiting device for the lamp.
Carbon Electrode for Arc Lamps, J. M. Lacombe, Paris, France, 506,650. Filed Aug. 27, 1892.
Composed of plates or discs of carbon arranged side by side and having between them a steadying substance, the whole being united by pressure.

Miscellaneous:—

Electric Car Lighting System, F. E. Kinsman, Plainfield, N. J., 506,237. Filed Sept. 18, 1890.
The invention consists in providing means whereby the dynamo may be connected and disconnected from its driving wheel so that when the steam pressure rises above that required for turning the wheel at the desired speed the surplus energy may be utilized for operating the dynamo.
Process of and Apparatus for Purifying Water, G. Oppermann, Röbel, Ger., 506,248. Filed March 28, 1893.
The process consists in successively electrolyzing, agitating and heating the water.
Apparatus for Securing Synchronous Movement, R. J. Sheehy, New York, 506,271. Filed Dec. 31, 1887.
Employs a regulator consisting of supplemental circuit closers prolonging the circuit connections existing at any given time, and a speed controller momentarily cutting such devices out of circuit.
Electromagnet, I. A. Timmis, London, Eng., 506,282. Filed Feb. 1, 1893.
Electric Cigar Lighter, C. B. Struble, Minneapolis, Minn. Filed Jan. 10, 1893.
Coin Controlled Graphophone, C. S. Tainter, Washington, D. C., 506,348. Filed April 27, 1893.
Method of Treating Diseases Electrically, S. Silsbee, New Utrecht, N. Y., 506,449. Filed June 30, 1893.
Electrical Head Clamp for Relieving Pain, L. Lane, Dunellen, N. J., 506,516. Filed May 27, 1893.
Automatic Draft Regulator, H. L. Tyler, Corning, N. Y., 506,569. Filed March 25, 1893.
Electrical Transformer or Induction Device, J. M. and M. Adams, Elkhart, Ind., 506,577. Filed June 22, 1893.
Consists of the combination in an induction coil of a core and envelope connected to each other and held in proper position by wedges of non-conducting material.

Railways and Appliances:—

Means for Supporting Trolley Wires, S. Harris, Cleveland, O., 506,317. Filed June 6, 1893.
Supports the wire by means of a truss mechanism, thus rendering it more stable against lateral displacement.
Electric Locomotive, J. F. S. Branth, New York, 506,358. Filed March 23, 1892.
The invention consists in the method of securing the motor to the truck and transmitting its power to the wheels.
Electric Railway Trolley, G. H. Benjamin, New York, 506,463. Filed June 30, 1893.
Employs a vessel containing liquid the latter making contact with the trolley wire, and means for maintaining the supply of liquid in the vessel.
Trolley, G. F. Green, Kalamazoo, Mich., 506,492. Filed April 28, 1892.
A trolley especially adapted to use upon conductors laid in underground conduits.
Trolley Support for Electric Railways, J. M. Anderson, Boston, Mass., 506,617. Filed April 14, 1893.

Switches and Cut-Outs:—

Electric Switch, W. W. Alexander, Kansas City, Mo., 506,297. Filed Feb. 16, 1891.
The invention relates to a trip switch and especially to means for resetting it after it has been tripped.
Electric Elevator Switch, W. Hochhausen, Brooklyn, N. Y., 506,367. Filed Sept. 9, 1891.
Cut-Out, E. Thomson, Lynn, Mass., 506,353. Filed Oct. 27, 1888.
Employs a transformer with a primary of high self-induction in an uninterrupted branch around the part of the circuit containing the translating devices and a controlling circuit for a switch connected to, and supplied with current for bringing the switch into operation, from the secondary of the transformer.
Electric Switch, F. Stevens, Philadelphia, Pa., 506,563. Filed April 21, 1893.
A flush push button switch for incandescent lights.

Telegraph:—

Printing Telegraph, R. J. Sheehy, New York, N. Y., 506,269. Filed March 11, 1886.
Printing Telegraph, R. J. Sheehy, New York, N. Y., 506,270. Filed Jan. 10, 1887.
Printing Telegraph Exchange System, R. J. Sheehy, New York, N. Y., 506,272. Filed Dec. 31, 1887.
Consists in locating at a central point an alternating current dynamo connected with any one pair of main line conductors so that any two such conductors may be connected together and supplied with requisite currents for operation.
Printing Telegraph, R. J. Sheehy, New York, N. Y., 506,273. Filed Oct. 31, 1890.
Telegraphy, R. J. Sheehy, New York, N. Y., 506,274. Filed Dec. 23, 1890.
The invention includes an arrangement by which printing telegraph instruments are connected with and operated by current from an electric power circuit.
Autographic Telegraph, R. J. Sheehy, New York, N. Y., 506,275. Filed March 3, 1891.
Employs two surfaces moving respectively under transmitting and receiving styluses and a system for maintaining the two surfaces, which in this case are cylinders, in synchronous relation by a correction occurring once in each revolution.
Telegraph Transmitter, C. Willoughby, San Francisco, Cal., 506,294. Filed Dec. 6, 1892.
A printing telegraph transmitter operating like a typewriter.

Telephones and Apparatus:—

Telephone Tablet and Arm Rest, J. S. Gold, Columbus, O., 506,223. Filed May 18, 1892.
Magneto Telephone, J. A. Brown, Moline, Ill., 506,305. Filed July 26, 1893.
Employs a diaphragm located wholly without the field, the variation of which between the two poles of the magnet controls the pulsations of an armature which effects the transmission.
Telephone Transmitter, J. V. Capek, New York, 506,415. Filed July 19, 1893.
Employs a mass of comminuted conducting material resting upon a liquid cushion.
Variable Resistance for Microphones and Method of Manufacturing Same, A. C. Cousens, Boston, Mass., 506,627. Filed Jan. 9, 1893.
Claim 1 follows:
A composition of variable resistance for telephonic transmitter circuits containing titanium as the essential element.
Telephone Attachment, C. H. Dorenwend, Toronto, Can., 506,646. Filed June 3, 1892.
An attachment for the telephone receiver designed to obviate the necessity of removing the latter from the hook in order to use it.

LETTERS TO THE EDITOR.

TABULATING ELECTRIC RAILWAY REPORTS.

I BEG to call your attention to the error in the footing of the report given in your Vol. 16, No. 283, page 302, issue of Oct. 4, 1893, of the Troy City Railway Company for the year ending June 30, 1893. Similar reports are frequently printed in all the electrical papers and the writer's experience, is that they universally have errors in addition which should be carefully verified before being printed, as they are apt to mislead parties who desire to make use of them, and who do not stop to verify the figures.

These reports would also be of very much greater use to those interested in the topics to which they refer, if they were tabulated in such shape as to enable the eye to quickly catch any particular item. The chief value also of such reports is not so much in the actual figures for any given item of expenditure as in the ratio which that expenditure bears to the total expenditures of operation or betterment.

J. STANFORD BROWN.

NEW YORK, Oct. 16, 1893.

[Mr. Brown has drawn up in tabular form the items included in the note referred to, which shows that the betterments amount up to $191,517 instead of $188,266, and the total operating expenses to $368,348, instead of $228,584 as given.—EDS. E. E.]

THE WICKS QUAD RELAY.

REGARDING my criticism of the Wicks device for improving the neutral side of the quadruplex, permit me to say that the apparent objections quoted by Mr. Maver from the patent specification were the same that occurred to me. I was unable to produce with the instruments obtainable a sufficient difference of lag between the polar relay and the neutral bridge relay to overcome the break. I had seen no description of the arrangement before and naturally set it down as one more of the numerous devices that have been evolved for the same purpose, which have looked very pretty in a well drawn diagram but were more or less useless for the object sought to be attained.

D. B. GRANDY.

ST. LOUIS, Oct. 18, 1893.

MR. A. W. CONGDON, who has been for a long time with the Canadian General Electric Company and has recently been its agent for the Province of Quebec, has been appointed assistant chief engineer of the company with headquarters at Toronto.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE WASHBURN & MOEN MFG. CO.

THE WASHBURN & MOEN MFG. CO. have just completed an order for railway feeder wires given by the Brooklyn City Railway Co. This order included 180 miles of 500,000 C. M. stranded weatherproof feed wire, together with about thirty miles of another size. It represented a weight of about 2,000,000 pounds, amounting to about $300,000, and is believed to be the largest single order for insulated wire ever placed in this country. This company had previously furnished the Brooklyn City Railway with a quantity of this same style and size of wire, and the recent purchase was the direct result of the high quality of wire furnished by them and the very satisfactory manner in which the business was handled. The company have erected and equipped a large factory devoted exclusively to the manufacture of insulated wires and are pushing this department of their business in a very energetic manner.

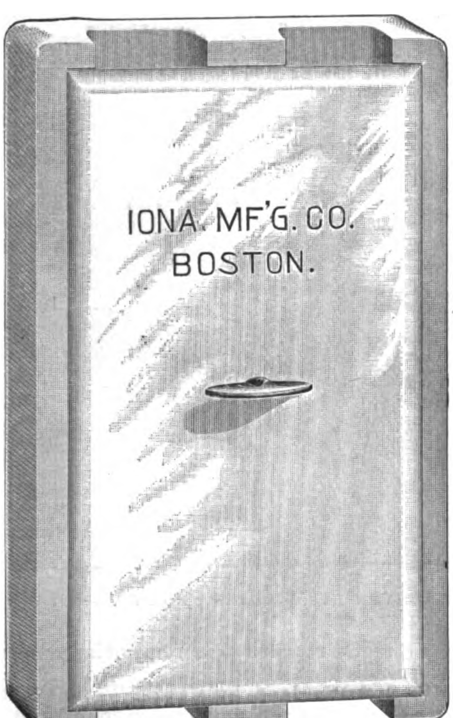
AWARDS TO THE DIXON COMPANY.

THE judges at the World's Fair at Chicago have made awards to the Joseph Dixon Crucible Company, Jersey City, N. J., for superior products in graphite, lead pencils, plumbago, crucibles, black-lead stoppers and nozzles, dippers, bowls, foundry facings and lubricating graphite.

These awards are a very proper recognition of the qualities of these goods, as the Dixon Company is known throughout the world as the pioneer in the graphite industry and its goods are always considered as the standard. The United States Government in its bids for supplies says, "Dixon's, or equal."

THE IONA MAIN CUT-OUT.

THE accompanying engraving illustrates a new style of covered main cut-out which is being introduced by the Iona Manufacturing Company, of Boston, and which possesses several features desirable to the practical wireman. The wire contacts are large and very strong, and the porcelain cover can be readily removed by unscrewing the thumb nut, when it is necessary to replace the fuses. The Iona Manufacturing Company will soon have a full line of these cut-outs, both branch and main, ready for delivery, and already report a brisk inquiry for them.



THE IONA COVERED MAIN CUT-OUT.

THE trustees of Thomson-Houston securities, series D, have declared a semi-annual dividend of 25 cents per share payable November 1, 1893. Transfer books will be closed from close of business October 24 until close of business November 1.

THE WILLANS ENGINE.

THE Willans central-valve engine, which has met with such enormous success in English central stations, is single-acting, having all its brasses constantly in compression to enable it to run at high speed without knocking; the *piston speed*, however, is lower than in most engines, and the wear in cylinders and piston-rings is consequently small, while that in the brasses, owing to the total absence of hammering and of back-lash, is very small indeed. The valves (of the piston type) Fig. 1, work inside the piston-rods, and give an excellent distribution of steam and drainage for water, and the high speed of the engine is conducive to economy. With a small engine indicating only 90 h. p. (at 400 revolutions per minute) a consumption of less than 18 pounds of steam per i. h. p. per hour, condensing, has been recorded, and a little over 18 pounds non-condensing.

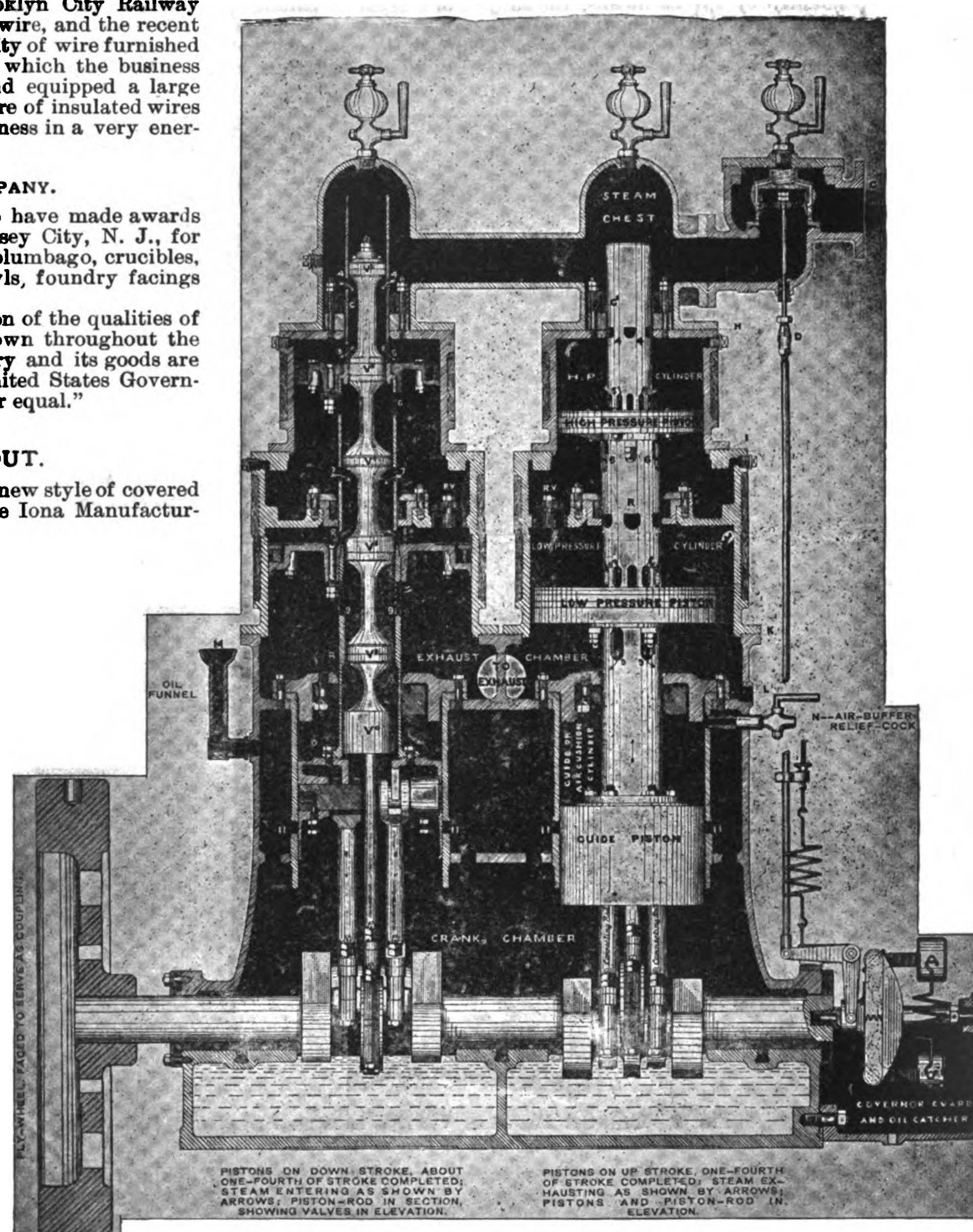


FIG. 1.—THE WILLANS CENTRAL VALVE ENGINE.

Each line of pistons is connected to its corresponding crank by two exactly similar connecting rods, with a space between, in which works an eccentric, forged solid upon the crank-pin. The connecting-rods work at the top upon two hardened steel pins, so supported that the pressure of the rods exerts no twisting strain upon them; the eccentric rod plays in the space between.

The eccentric is on the crank-pin, and not on the shaft as usual, as the valve-face (*i. e.*, the inside surface of the hollow

piston-rod) moves with the pistons. Consequently the valve-motion required is a motion relative to the pistons, and this is obtained by mounting the eccentric on the crank-pin.

It will be noticed that the upper crank-pin brasses of the connecting rods are wider than the lower ones. This is because the upper brasses alone are intended to be in actual contact with the crank-pins; the lower ones are only a stand-by in case of accident. All the moving parts of the engine are designed to be strictly in constant thrust and the connecting-rods are always in compression. From the fact that the upper or working brasses never leave the crank-pins, and so are never exposed to hammering action, however slight, they exhibit great durability when properly lubricated. Very little compression is given in the steam cylinders, for little or none is required; the requisite cushioning is obtained independently by special means, the subject of a separate patent. It is in fact provided, without the addition of a single moving part to the engine, *by the guide pistons*. These, on the up stroke, compress the *air* contained in the guide cylinders, and thus any

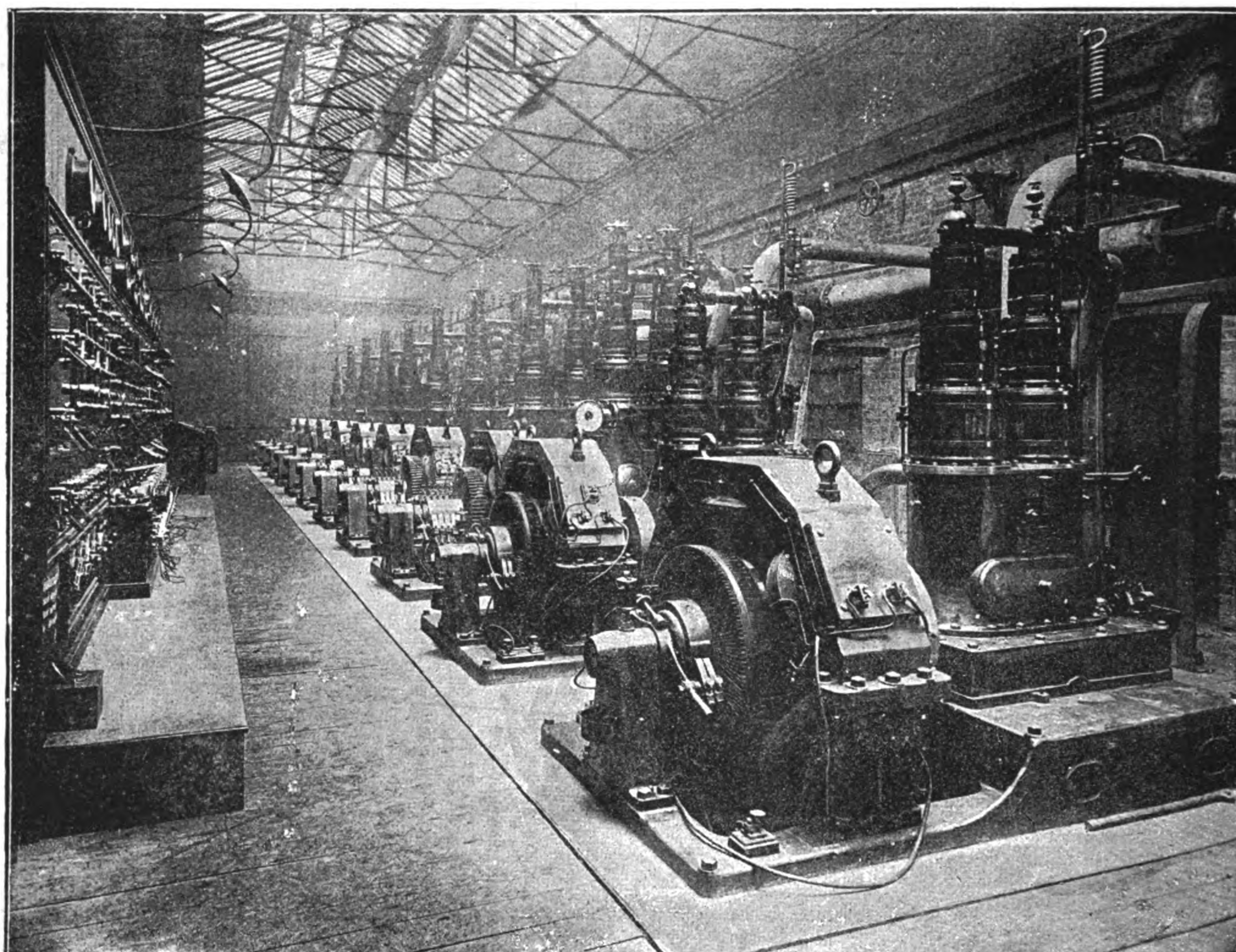


FIG. 2.—THE ST. PANCRAS VESTRY LIGHTING STATION—DYNAMOS DIRECT DRIVEN BY WILLANS ENGINES.

desired amount of cushion can be obtained, according to the clearance allowed.

This engine is extremely popular in England, and is being rapidly introduced on the continent for all electrical purposes, all of the large electric companies having arranged to build special dynamos to be connected direct to the engine shaft, thus making a great saving of valuable space. The report of sales from the English manufacturers up to the present date show over 70,000 h. p. either running or on order.

Fig. 2 shows a part of the St. Pancras Vestry lighting station, London, where there are eleven of these engines directly connected to dynamos. The engines are of the triple expansion type. The dynamos are all continuous current machines, having six poles. These dynamos are of the Kapp type. Nine of the machines are wound for an output of 680 amperes at pressures varying from 112 to 130 volts. Three are capable of giving 145 volts, with a small current for charging batteries at a sub-station. They can be worked as self-exciting simple shunt machines or separately excited.

One of the most striking features of this and other central lighting stations equipped with central-valve engines is the arrangement of a line of combined engines and dynamos of 100 200 and 300 h. p. units, coupled up in parallel, so that all but one of the engines are loaded to their full capacity, while the one partially loaded engine (all of the other governors having gone out of action) is doing all the governing. In other words, it takes care of all variations or fluctuations of load within the limit of its capacity.

There are several of these engines at the World's Fair, some in actual operation and still others forming part of standing exhibits. In Machinery Hall is one of 365 h. p., running at 370 revolutions, driving a Siemens Bros. & Co. dynamo for the Schuckert search lights on Manufactures Building; one of the same capacity at 300 revolutions belted to line shafting; two others, of 165 and 50 h. p., respectively, performing similar service; and one of 100 h. p. directly connected to a dynamo. In Electricity Building are two more, the one directly coupled to the great Brush 120 arc light generator and occupying a conspicuous position in their splendid exhibit, and the other directly coupled to a multipolar generator in the General Electric exhibit.

These engines are built in England by Messrs. Willans & Robinson, Ltd. of Thames-Ditton, Surrey, and in this country by the M. C. Bullock Manufacturing Company, 1170 Lake street, Chicago, Ill., the exclusive licensees.

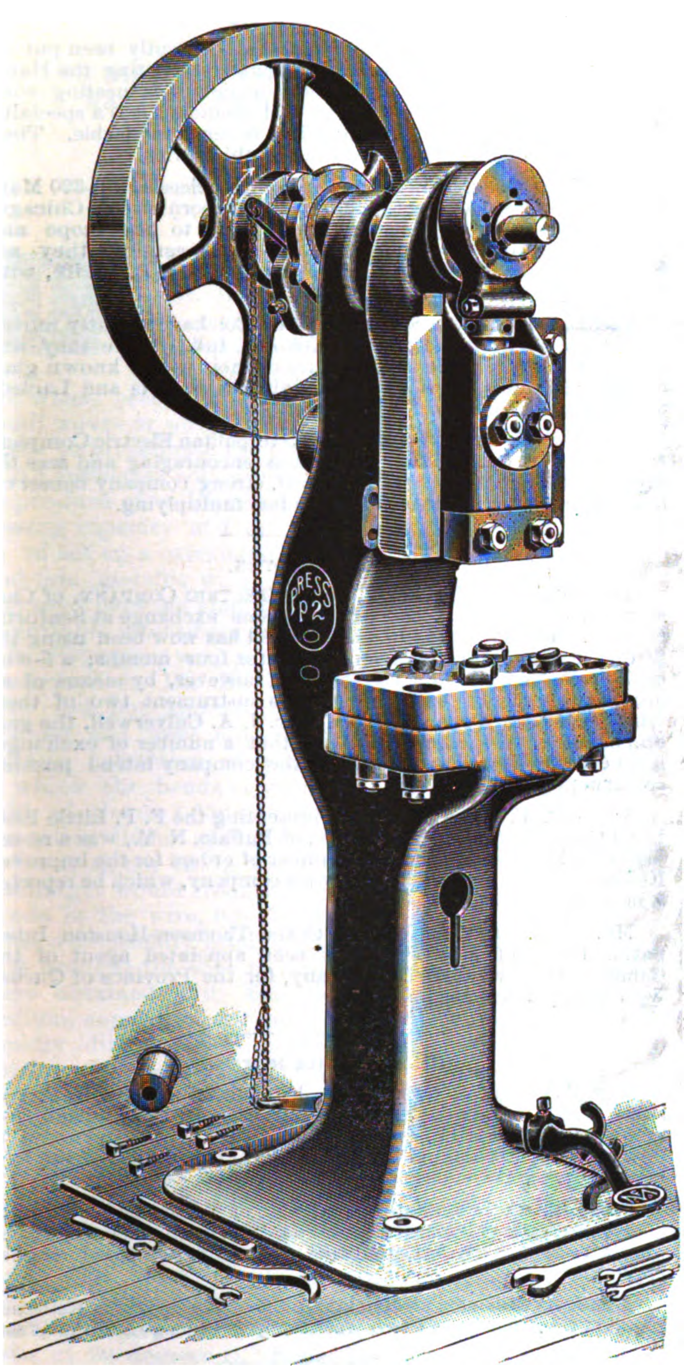
DESTRUCTION OF THE BRUSH ELECTRIC COMPANY'S BALTIMORE PLANT.

THE Brush electric light plant of Baltimore was totally destroyed by fire on the night of Oct. 13. The wind blew a gale, and showers of sparks were carried great distances. Rain, however, had been falling in torrents for hours, and the drenched condition of everything out of doors helped the firemen in their efforts to confine the flames to the block bounded by Madison, Monument, Constitution and Graves streets.

As a consequence of the destruction of the Brush electric light works, the city will be in comparative darkness for some time, as there is no other plant equipped to supply street lights. The loss to the Brush company is about $200,000.

NEW FERRACUTE PUNCHING PRESSES.

The accompanying illustration, which is drawn to a scale of $\frac{1}{12}$, represents a machine recently brought out by the Ferracute Machine Co. of Bridgeton, New Jersey. By their new system of classification it comes under Class P, punching presses, and being of the second size is known as "Press P 2." Its weight is about 1,500 lbs. In the same series are five other sizes, one smaller and four larger, P 1 weighing about 900 lbs., while P 3, P 4, P 5 and P 6 weigh 2,400, 3,900, 6,000 and 8,700 lbs., respectively, the design being the same in all. This series of machines is also built with back-gearing (the gears all cut) in which case the letter G follows the class-letter and the symbols thus become PG 1, PG 2, etc.



The "P. 2." Ferracute Press.

The frame of this press is hollow and of very rigid proportions, having the tensile and compressive members of those parts which act as a beam arranged with internal ribs. This construction gives great rigidly against torsion in the upright part, back of the throat, so that the upper die is not easily sprung laterally away from true alignment with the lower one. The pitman is of recently improved construction, its stem, while having the advantage of a screw adjustment, being so firmly gripped both at its upper and lower ends, in the pitman pivot and strap respectively, as to give the effect of solid metal between shaft and ram, these gripping devices at the same time being very delicate in their adjustment.

The ram is unusually heavy and is arranged with very long and wide bearings; an extra long pitman adjustment, graduated to hundredths of an inch; proper arrangements for clamping various kinds of punches; a positive knockout when desired, etc. The bolster can be made to order with various sizes of central hole, and is provided with die-clamps, adjustable in tee-slots upon the top face thereof.

The shaft is of forged steel with unusually large and long journals. In an enlargement of its solid metal is mounted an automatic stop-clutch of the utmost simplicity, and which, withal, has its different members so interlocked with each other in the process of assembling, as to require no nuts or screws whatever—these being objectionable in a device of this kind where the tendency is constantly to knock them loose. This clutch is provided with a safety-lock which, while performing other functions incidentally, can be so manipulated as to prevent the press from starting while dies are being set, etc. A new and valuable feature consists in a so-called "clutch-plate," carrying the tripping device, which is adjustable around the shaft's axis, thus allowing the clutch to be tripped either earlier or later than the normal, to accommodate itself to varying degrees of momentum in the shaft and parts attached thereto, this momentum being dependent upon the conditions of speed, lubrication, extra weight upon shaft (as cams, gears, pulleys, etc.) and other circumstances which usually have to be controlled entirely by a brake, thus in many cases losing a large amount of power. In the hub of the fly-wheel, besides four hardened wheel-studs for driving, there are also mounted self-acting locking-pins which, while allowing the clutch-slide in shaft ample time to enter spaces between wheel-studs, finally lock the same after entering and thus prevent the annoying back-lash incident to the use of spring-drawing dies and elastic works of various kinds.

In general, this machine is characterized by carefully proportioned parts, great weight and inertia to those submitted to heavy stresses, harmonious curves, heavily rounded corners, absence of external ribs, case-hardened bolts and nuts of large diameters, etc.

"Press F 32" has a frame, legs, etc., which are duplicates of the foot lever press "F 2," and therefore has many parts interchangeable therewith, thus being cheaper and quicker to manufacture. An especially valuable feature is an encased screw which is protected from dirt and injury by being inside of the ram, while at the same time the weight of the screw, wheel and lever, give aid to the downward force thereof, so as to vary its height and its amount of working leverage.

The weight of this press is about 800 lbs.

The designers and makers of this machine build also some 400 or 500 other sizes and kinds of foot and power presses for working sheet and bar metals of all sorts.

THE CENTRAL ROUTE TO CHICAGO.

Now that the travel to the World's Fair is beginning to assume large proportions, the wisdom of the New York Central management in providing for it, so far in advance, is becoming apparent. The new equipment, comprising elegant Wagner palace, sleeping, drawing-room, buffet and dining cars, handsome new coaches and powerful engines, has proven ample to handle the increased business without any discomfort or delay. The great 20-hour flyer, the Empire State Express, and the other limited trains of the Central are the wonder and admiration of the world of travel. Reduced rate excursion tickets to Chicago and return are on sale at all offices.

TEMPERED COPPER COMMUTATORS.

One of the latest testimonials received by the Eureka Tempered Copper Co. in behalf of the excellence of their goods, is that from J. L. Adams, Jr., of Springfield, Ill., under date of Oct. 14, in which he says: "I could hardly have desired a better commutator; under wear, instead of grooving, the surface became polished and smooth, and as yet no wear is perceptible. You can rely upon hearing from me when in need of another commutator."

The F. P. Little Electric Construction and Supply Co., of Buffalo, are meeting with great success with their Kester arc lamps which are made to go on all kinds of circuits. The lamps may be placed on any system of wiring from 50 to 500 volts constant potential.

The Kester commutator compound, also made by the F. P. Little Company, prevents sparking and cutting of the commutator on all electrical machinery where either copper or carbon brushes are in use. Electric street railway companies will find it especially valuable, for if properly applied to the motor commutators it greatly reduces the cost of repairs. The compound has been used for several years in many central stations.

DISSOLUTION OF PARTNERSHIP.

MESSRS. C. C. STIRLING AND R. W. NEY, doing business under the name of the Stirling Electric Company, have terminated their partnership. Mr. Stirling relinquishes all claim in and to the machinery, tools, accounts receivable, and other assets, and Mr. R. W. Ney holds himself accountable and liable for all moneys owing and debts contracted by the Stirling Electric Company under the partnership. Mr. R. W. Ney will continue the manufacture of dynamos and motors at Mechanic street, and Mr. C. C. Stirling will continue the manufacture of electrical instruments at the Courant Building, Hartford, Conn.

JULIUS ANDRAE.

A VERY interesting catalogue and price list of electrical goods and supplies has just been issued by the veteran Julius Andrae, of 225 West Water street, Milwaukee. It is prefaced by an admirable portrait and autograph of the head of the house, who mentions in his modest little preface that the business was established in 1860. The catalogue, called "No. 2," is in two sections. The first is devoted to electrical house goods. The second part deals with electric light supplies, and the arrangement of both is excellent, greatly facilitating the search of the intending customer for the goods needed. The catalogue is very complete, occupying no fewer than 130 pages, while the index of goods fills two closely packed pages. There are also to be noted various specialties of merit, such as the "Milwaukee" commutator brush, made of graphite and electro-deposited copper; the Andrae shade holder, etc. Reference is also made of the goods and apparatus which Mr. Andrae represents so well in his territory.

THE E. G. BERNARD COMPANY.

THE E. G. BERNARD COMPANY, of Troy, N. Y., have received official notice from the U. S. Ordnance Department, that they have been awarded the contract for the new lighting and power plant at the Watervliet Arsenal. The system is the Siemens-Halske 3-wire. The contract calls for arc lights throughout the grounds, incandescent lights in the quarters and through the immense gun shops, and also motor power for the machinery and heavy traveling cranes for lifting the large guns during the different stages of manufacture.

There will be five dynamos of 48 k. w. capacity and a sixth dynamo of larger size, furnishing current for 6,000 lights. The new plant is to take the place of the one now in use. In the contest for this contract, the Bernard Company competed with the largest electric lighting companies in this country.

ELECTRICAL WORK IN PHILADELPHIA.

THE ELECTRICAL COMMITTEE OF COUNCILS have agreed to recommend a total appropriation of $219,500 for 1894. An item of $10,000 was added for beginning work on a conduit along the east side of Broad street, north and south from the City Hall. There is now a conduit along the west side of the street, but it is deemed important to have one on each side. The new one will be laid under the sidewalk.

ELECTRICITY IN DETROIT.

MAYOR PINGREE, of Detroit, is agitating the subject of a municipal telephone exchange. He is also interested in a universal electric lighting ordinance which recently passed the council, the first sentence of Sec. 1, of which is as follows:

> That any person or corporation carrying on a manufacturing business in the city of Detroit and having surplus power applicable to the purpose, may apply to and receive a permit from the public lighting commission to lay conduits, erect poles, and place thereon or therein wires or other conductors for the purpose of furnishing electric lighting to any person or persons desiring the same and within the district to be designated in the application to be made for such permit.

NEW YORK NOTES.

THE MICA INSULATOR COMPANY, of New York and Schenectady, made a fine display at the meeting of the American Street Railway Association in Milwaukee. This was the first time this company has made an exhibit of Micanite. Micanite is surely and steadily being adopted as a reliable insulator, not only in the United States but in Europe. This company have made several important improvements in the method of manufacture and say that the Micanite of to-day is far ahead of what they put on the market when they first began business. The exhibit was in charge of Mr. Charles W. Jefferson, their manager, who is thoroughly posted on insulation. Mr. Jefferson was for several years manager of the insulating department of the Edison General Electric Company, at Schenectady.

THE C. MCINTIRE CO., of Newark, N. J., have received an award of merit from the Franklin Institute, of Philadelphia, for their compound electric wire.

WESTERN NOTES.

AMONG the sales recently made of the Stirling water tube safety boilers, are the following:

> Adriance, Platt & Co., Poughkeepsie, N. Y., manufacturers of Buckeye mowers and reapers, 250 h. p.; Simpson & Watkins, Scranton, Pa., three boilers, second order, 250 h. p.; Lutz, Lilly & Co., Philadelphia, Pa., second order, 250 h. p.; West Farms station of the Union Railway Company, New York City, 500 h. p. recently put into service, and an additional 500 h. p. ordered.

The company have received numerous letters showing the use of the Stirling boiler as compared with the ordinary type of water-tube boiler working side by side, the statements being highly satisfactory to the former and bearing out their claims for circulation, self-cleaning and economical fuel consumption.

AMONG the new specialities which have recently been put on the market, the Central Electric Company are listing the Hammond cleat. They state that this new device is meeting with considerable favor, and that they feel confident it is a specialty which has come to stay, and certainly is very practicable. They will furnish special circulars bearing on this device.

THE METROPOLITAN ELECTRIC CO., with offices at 319–320 Manhattan Building, and salesroom 307 Dearborn street, Chicago, will make an announcement shortly as to the scope and general plan of the company. In the meantime they are receiving orders for general supplies and "N. I. R." wire, with which they are generously stocked.

THE LACLEDE CARBON AND ELECTRIC CO. have recently moved their large factories and plant to Kokomo, Ind., where they will hereafter carry on the manufacture of their widely known glass and porcelain insulators, cut-outs, switches, sockets and Laclede and Hercules batteries.

MR. WM. H. MCKINLOCK of the Metropolitan Electric Company feels that the outlook for business is encouraging and sees the promise of liberal support for a good, strong company conservatively managed. Evidence of this is fast multiplying.

CANADIAN NOTES.

THE AUTOMATIC TELEPHONE AND ELECTRIC COMPANY, of Canada, has opened an automatic telephone exchange at Seaforth, Ontario. The adjacent town of Mitchell has now been using the Strowger automatic telephone system for four months; a 5-wire cable being employed. At Seaforth, however, by means of an auxiliary switch on each subscriber's instrument two of these wires have been dispensed with. Mr. J. A. Culverwell, the general agent of the company, states that a number of exchanges have been organized upon which the company intend pushing construction.

MR. WM. F. BREIDENBACH, representing the F. P. Little Electrical Construction and Supply Co., of Buffalo, N. Y., was a recent visitor to Montreal. He had a number of orders for the improved Kester arc lamp manufactured by his company, which he reported was meeting with great success.

MR. W. F. DEAN, formerly with the Thomson-Houston International Co., of New York, has been appointed agent of the Canadian General Electric Company, for the Province of Quebec with headquarters at Montreal.

PHILADELPHIA NOTES.

THE PARTRICK & CARTER CO. have fitted out the U. S. war ships *Texas*, *Roanoke* and *Amphitrite* with their metal case moistureproof marine annunciators. Mr. T. L. Townsend is now making his annual Western tour in the interest of the Partrick & Carter Co.

THE EUREKA TEMPERED COPPER CO., of North East, Pa., have been awarded a premium, a medal and honorable mention by the World's Fair Awards Committee for their tempered copper specialties.

MR. JOHN MCLEER, electrician for the Pennsylvania Railroad, has just returned from a two weeks' trip to Chicago and the West.

NEW ENGLAND NOTES.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have received the contract for the new drawbridge at Salem, Mass. The bridge will have a 60-foot opening with a roadway 26 feet wide in the clear and two sidewalks each 6 feet wide. It will be of deck plate girder construction.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

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ON THE DISTORTIONS OF FINE WIRES CONDUCTING RAPIDLY OSCILLATING DISCHARGES.

BY

A. E. Kennelly

IN the London *Electrical Review* of September 8, Dr. Bleekrode describes some interesting phenomena, first noticed, it would seem, by Becquerel in 1837, produced by rapidly oscillating discharges through fine platinum wires, the wires becoming bent and permanently contorted in small waves or serrations. The following experiments were made to investigate the phenomena.

An induction coil, excited by an alternator, was arranged to produce at will spark discharges through a circuit possessing capacity and non-ferric inductance of such values as to set up a calculated frequency of roughly 500,000 ~, and fine metallic wires from 5 to 50 cms. in length were included between clamps in this circuit. When discharges of suitable intensity were allowed to pass through the circuit, distortions were produced in the wire, as described and illustrated in Dr. Bleekrode's paper. The bends in the wire did not appear to follow any law of gradation or spacing and were not confined to any plane or apparent definite succession of planes. Neither could the plane in which the bends occurred be controlled by a magnetic field of about 1,000 C. G. S. units of flux density. The distortion did not appear to depend upon the length of wire under trial, nor on its form—looped or straight. Feeble discharges would frequently produce numerous small wavy bends in the wire, but the largest and most abrupt distortions were usually established by more powerful discharges that brought the wire to a red or white heat. The results were obtained with fine wires of platinum, platinum-iridium, copper, silver, and german-silver, but in all cases rapidly diminished with the diameter of the wire. By passing the discharges through two parallel wires in contact, these became fused together, but remained separate at sharp bends, so as to form a delta, showing that the distortion preceded the interfusion. The medium surrounding the wire did not seem to influence the effects which were produced in wires supported in air, water, oil, or highly exhausted glass tubes. The effect was not destroyed when the wire was hammered out into a thin flat strip. The best results were obtained with wires of platinum alloyed with 10 per cent. of iridium, having a diameter of 0.008 cm. and a resistivity of about 27,800 C. G. S. units at 20 degrees C. Some bends were so abrupt as to contain an angle of more than 90 degrees. Microscopic examination of the more prominent bends with a linear magnifying power of 80, frequently revealed holes or craters in the surface of the wire at the bend, sometimes at the concave, at other times on the convex side. Further examination showed that at numerous smaller bends similar minute craters or vent holes could be discerned. In a large proportion of the small bends no such external cavity could be detected, but by cutting the wire with a sharp pair of scissors at the bend, an internal cavity was often found in the cross-section with the microscope, but as it was often difficult to cut the wire with sufficient precision, the fact that such sections frequently failed to reveal internal cavities was not considered as a strong objection to the hypothesis that each bend in the wire was accompanied by a cavity at some point in the cross-section at that spot.

Experiments were next made with the same size of wire when heated with continuous currents. When the current was slowly increased to the fusing strength—1.4 amperes—the surface of the wire under the microscope showed numerous minute cracks or fissures, but bends or contortions, if present at all, were very faint. When the fusing current, however, was applied suddenly, the bends and distortions were again occasionally produced and these often revealed the same miscroscopic cavities either in the surface of the wire or on its cross-section.

The above observations suggest the theory that the distortions in the wire are produced by the sudden expansion of minute quantities of gas occluded within the substance of the wire. If the crevice containing the gas happens to reside near the axis of the wire, the pressure developed by thermal effect of the current would probably be uniformly resisted by the walls of the chamber in the equatorial plane when viscously yielding at the fusing temperature, thus producing a local protuberance or enlargement of diameter, a condition frequently observed. As, however, the position of the gas chamber becomes more distant from the axis, the resistance of the side walls will relatively diminish on the side nearest the surface, so that the viscous yielding of the substance would no longer be uniform in the equatorial plane, causing distortion of the wire. So far as it has been possible to observe, the internal cavities have generally appeared upon the cross-section towards the convex side of the bend, as this supposition would require. When the increase of temperature is gradual, the occluded gas may frequently find an opportunity to escape slowly under its augmenting pressure, without distorting the walls of its chamber, but when a continuous current of fusing strength is suddenly applied, the rapidly increasing pressure acts upon walls that are already softened by heat, and might tend to set up a degree of mechanical distortion determined by the quantity of gas, its amount and rate of heat absorption, the geometrical conditions of its environment, and the elastic properties of the wire's substance during the period of heat application. If the gas chamber is near the surface, there may be an explosion of the outer wall whose reactive momentum will be expended in bending back the already softened wire.

It is reasonable that the mechanical violence of these effects should reach a maximum with brief and rapidly oscillating high tension discharges.

It is also known that the quantity of gas occluded by an ordinary platinum wire is such as to considerably diminish its capacity for long sustaining an incandescent temperature unless that gas is aided in effecting its escape by prolonged annealing in vacuo.[1]

It can be shown that the difference in distribution of current density through the substance of a wire having the diameter and resistivity above considered is very small for frequencies of one million periods per second.

1. Vide a paper "On the Phenomena of Heating Conductors by Electric Currents in Vacuo," by Thomas A. Edison, *Proceedings* of the American Association for the Advancement of Science, 1879, page 173.

COPPER COATING THE HULLS OF VESSELS ELECTRICALLY.

The disadvantages, causing at times actual disability of high-class vessels with steel hulls, have been emphasized by recent reports of the U. S. Navy Department. It is well known that the vessels of our Navy, and other steel vessels, have to be docked at intervals of four to six months for cleaning and painting the bottoms, owing to the accumulation of marine growths, which operation often involves serious loss of time and great expense.

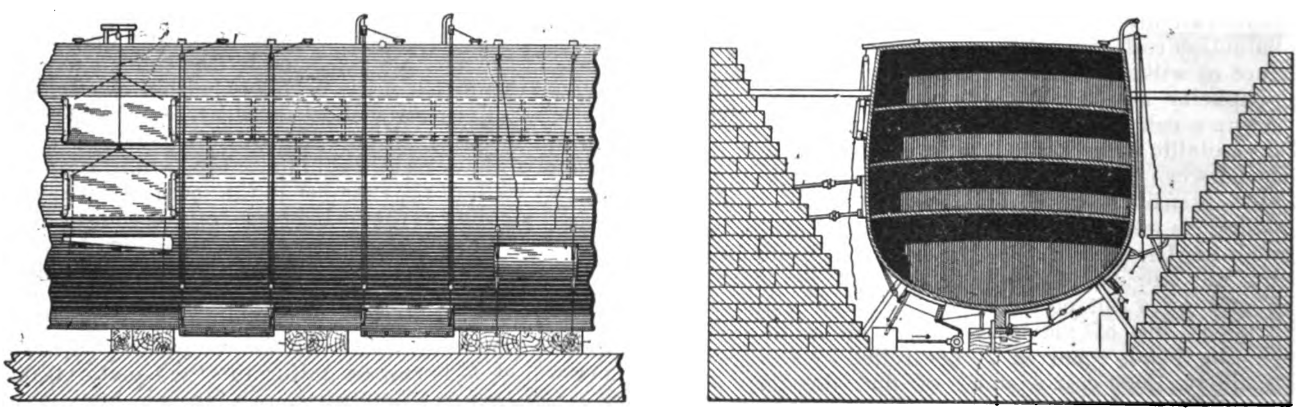
Chief Naval Constructor Wilson in his argument for copper sheathing, submitted a letter from Commander Philip of the *U. S. S. Ranger*, under date of June 22, 1892, in which he called attention to the fact that with a clean bottom the ship readily made 7 to 8 knots on 7 tons of coal, while with a foul bottom she only made 6 knots though burning from 12 to 14 tons of coal per day. The Chief Constructor also reports that in efforts to discover some means for the prevention of fouling, "thousands of dollars have been expended in the testing of protective and anti-fouling paints and compounds with results which give but very little encouragement to further experiments."

Copper in the form of a sheathing is the only practical preventive now known. It is evidently impossible to attach loose sheets of copper to steel hull without inviting injurious galvanic action, and the English in their efforts to obviate this difficulty have already adopted upon their war ships a wooden sheathing four inches thick to insulate the copper from the hull.

The great advantages are obvious, therefore, of any method for attaching or depositing a coating of copper in an unbroken sheet over the whole bottom of the vessel, and various means for the attainment of this object have been suggested from time to time. Until recently, no means had been found for effecting this object, except to convert a dry dock into an immense galvanic bath, and operate upon the whole surface of the vessel simultaneously. Such a method, although patented many years ago in the United States and England, is utterly impracticable and has never come into use. What appears to be a practical means for attaching a copper coating inseparably to the steel or iron hull has been recently devised and utilizes old and well known processes of electroplating with entirely novel apparatus.

Chief among the difficulties to be encountered in plating the whole hull at once, aside from the vast expense for the electrolytic solution and the enormous amperage required for the deposition of the copper plate, would be the supreme difficulty of adequately cleaning the extensive metal surface and preventing oxidation before the act of plating could be begun, thus rendering impossible the deposition of a continuous coating which would be integral with the hull. Moreover, this method involves the bringing of the vessel to and immersing it within the electroplating bath. But why not deal with smaller bodies and lesser difficulties by bringing the bath to the vessel? The latter is the plan adopted by Mr. Thomas S. Crane, of East Orange, New Jersey, who has recently received a patent for this method.

Mr. Crane's method, which is illustrated in the accompanying engravings, consists primarily in the use of flexible, shallow, box-shaped baths, open at one side. Each bath contains a copper electrode and the plating solution, the bath being made water-tight by suitable flexible packing at the edges. Several of these baths are used in the plating of the vessel when in dry dock or upon the stocks, the cleaning of the hull at any one time being only necessary in the places where the baths are to be applied. The baths, which are made flexible in order to follow the curvature of the vessel, are readily supported against its side, on its bottom and along its keel and in other difficult situations, by comparatively simple means, such as tension ropes, screw shores or by magnets attached to the frame of the bath. The vessel is made the negative pole by connection with an electric generator; the plating bath furnishes the positive electrode, and the plating of the entire hull is readily accomplished by shifting the baths from the plated to the unplated sections, and slightly overlapping upon the sections already plated so as to form a continuous coating.



Figs. 1 and 2.—Method of Copper Coating the Hulls of Vessels Electrically.

It has been found that a current rate of 7½ amperes per square foot and a difference of potential of 1½ volts are sufficient to deposit a perfectly uniform, smooth and adherent coating to the metallic surface of the vessel. In order that the density of the solution may be kept uniform during the plating process, circulation is effected by permitting the solution to flow into the bottom and out near the top of the bath.

To illustrate the practicability of the method, let us take a ship of ordinary size as an example. A vessel 400 feet long, drawing 20 feet of water, has about 24,000 square feet of surface below the water line. Assuming that one-half of this surface is plated at one time, the current required at 7½ amperes per square foot would aggregate 90,000 amperes, which would be furnished by several dynamos if desired; and the power required to deposit the copper would be equivalent to about 185 h. p. A single deposit of suitable thickness can be made in less than three days, and the whole bottom of the ship can thus be plated in eight or nine days, using about 55,500 pounds of copper, which at 11 cents per pound would cost $6,105.

This method is applicable to any vessel now in existance and apparently offers a solution of this heretofore unsolved problem. The Ship Copper Coating Company, of Newark, N. J., has been formed to introduce this method of plating the hulls of ships with copper.

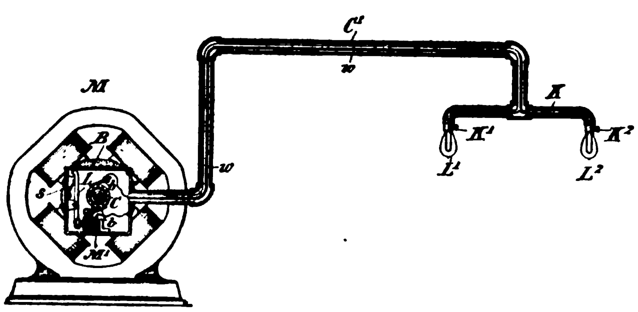
A SAFETY SYSTEM OF ELECTRIC WIRING.

BY

C. J. Kintner

INCREASED rates of insurance upon buildings supplied with electric light plants and numerous accidents both to persons and property traceable to such plants make it an absolute necessity that some system of wiring should be devised which will prevent all possibility of accidents of the nature indicated. To this end I have devised what I term a "Self-Inclosed Safety System of Wiring" in which all of the conductors from the generator to the translating devices, such as lamps, motors, or the like, and all of the dangerous parts of the generator are wholly enclosed or concentric.

This system will be fully understood by referring to the accompanying drawing in which M represents a dynamo and C′ a concentric conduit of conducting material extending from the dynamo to the chandelier K also of metal, the return circuit being in each instance an insulated conductor W which is connected, as shown, in multiple, directly to the lamps at one end and at the other end to one of the commutator brushes *b* resting upon the commutator C, the other brush *b* being connected to a conductor which is in turn electrically connected through a magnet M′ with a metallic boxing or casing surrounding the entire commu



KINTNER SAFETY SYSTEM OF ELECTRIC WIRING.

tator and commutator brushes and provided with a hinged lid or cover B. L is a locking armature adapted to lock the lid in closed position when the dynamo is running and the electromagnet M′ is energized, the arrangement being such that all of the dangerous conducting portions of the entire system are absolutely inaccessible to any one when the dynamo is in operation. When the dynamo ceases to run, the armature L is withdrawn from its energizing magnet M′ under the influence of the spring S so that the cover B may be opened and the brushes and conducting parts examined.

It will of course be understood that the commutator brushes might be carried by the usual form of rocker arm and adjusting handle accessible to the attendant for the purpose of shifting them as desired, and also that in the use of an alternating current machine the electromagnet M′ might be replaced by a solenoid, the movable or core portion of which would be in the nature of a coil in derived circuit from the energizing coil, this movable coil being attached directly to the armature lever L. I should prefer to connect the entire system directly to earth in order to avoid shock from static electricity. The conduit C′ would of course be watertight and the entire system would unquestionably prevent any possibility of an accident of any nature; the worst accident which could occur resulting in a short circuit at any point within the concentric system which would simply blow the fuse nearest the short circuit.

With such a self-inclosed or concentric system there is no possibility of an accident to any person either in the dynamo-room or elsewhere as the dangerous parts of the entire apparatus are wholly secured. With modern rules of wiring there is seemingly a very bitter antagonism to earthed circuits. It is difficult to see how a concentric system like that herein described can be objectionable when the exterior conductor is earthed, for the reason that the conductors are self-contained and there is no possible way by which the working current can be diverted from the self-inclosed system.

By thoroughly insulating the interior conductor *w* and by utilizing removable covers for the conduit C′ the entire system is accessible at all points and at least 50 per cent. of the wiring is saved, the conduit itself being used as a return circuit. With this system no inductive effects would be felt in neighboring circuits. No cross circuit can occur with neighboring circuits; no fire can occur, as a short circuit expends itself internally; no shocks can be obtained, as, being connected with the earth all static charge is conveyed away. Lightning cannot affect either the generator or the translating devices for a similar reason.

A NEW FIBROUS INSULATION AND ITS BEARING ON UNDERGROUND TELEGRAPH LINES.

BY

Chas Cuttriss

AMONG the various electrical industries which of late years have reached enormous proportions due to the remarkable advancement in electrical science not the least in importance is the manufacture of insulated wire.

Insulated wires may be very properly divided into two classes. First, those that depend upon the insulating coating of elastic gums, such as india rubber in any of its many forms of manufacture, or gutta percha. Second, those that depend upon a covering of fibre (such as a yarn of any kind) to keep the wire central, which is afterwards saturated with some of the many insulating materials and protected from moisture by an outer sheath of metal, upon the integrity of which the insulation of the wire depends.

Each of these classes have their special fields of usefulness. India rubber and gutta percha insulated wires are used for submarine cables or when a metal protection is applied they are also largely used for underground and interior construction. The fibre insulation when protected with a metal covering or sheath is generally used for underground work but large quantities are employed in the overhead construction of telegraph and other circuits without the metal covering. During my experience with telegraph circuits it has often occurred to me that a wire embracing in part the qualities of an india rubber or gutta percha insulation with the cheapness of a fibre covered wire was a great desideratum and I saw no reason why such a wire should not be produced. To this end, I have, in connection with Mr. A. A. Knudson, worked for the last two years, and the result has been a new insulated wire which can be confidently stated to be far superior to any of the existing fibre insulations and in some ways better than india rubber or gutta percha.

One trouble incident to the use of bunched cables, as they are termed, or cables consisting of many fibre-insulated wires contained in one metallic sheath is the fact that any mechanical damage to the sheath means the loss of many, if not all, of the wires as the moisture from the ground or conduit in a few hours will so penetrate the cable that the wires become crossed and grounded to such an extent as to be useless for telegraph circuits. It was one or two experiences of this nature that spurred me on to produce a wire that would combine the cheapness of

fibre with the moisture-resisting properties of india rubber or gutta-percha. In order to do this it became necessary to make the layer of fibre as nearly as practicable homogeneous and for this purpose all yarns or manufactured fibres had to be discarded. Experiments were then begun on raw fibres of different kinds and ultimately cotton in the form of a sliver as it comes from the cotton gin was found to give the best results.

The precise methods of manufacture need not be detailed here but it is sufficient to state that the wire is so covered with this sliver that before saturation with the insulating material it is so densely compacted round the wire that considerable pressure is necessary to make an indentation. After this covering with cotton the wire is placed in tanks of insulating material and remains there until thoroughly impregnated; it is then drawn out and wiped off. For making bunched cables and many other purposes, no further treatment is necessary, but where exposed to the abrasion a braid can be applied and the exterior finished in any of the well-known ways. The insulating material is of such a nature that all the ingredients are chemically combined for the reason that the fibres, being so densely compacted, act as a filter; hence if the insulating compound contained any material that was only held mechanically in suspension the suspended matter would collect on the surface and only the thin or liquid part of the insulating material would penetrate to the wire and not give to it the dense horn-like character that is the principal moisture-resisting quality.

When an ordinary fibre covered wire is bent round a small cylinder and the insulation cut so as to show the part near the wire or under the braid, an examination with a magnifying glass will show that the spaces between the yarns have become so opened that the insulating material fails to bridge the spaces, whereas in the new wire, a No. 14 copper wire can be bent round a lead pencil without any opening being discernible; in fact when the fibre is cut with a sharp knife it shows a clear, bright, dense shaving. If the ends of the wire are left in water for weeks the moisture does not creep back, and when wiped off and retrimmed, it is in perfect condition for jointing.

The tests for insulation on wire of this kind give surprising results. Samples of 10 and 20 feet have been immersed in water for two and three weeks without breaking down, showing that a cable composed of this wire would remain intact ofter the lead protection had been injured for such a length of time that repairs could be effected to the injured spot without the loss of any other wire than those mechanically injured in the first case. This feature in a fibre-covered wire for underground construction is invaluable and for overhead construction it is a very strong point in its favor, as I have not yet succeeded in breaking down the insulation by the repeated wetting and drying of two wires which have been twisted together. Hence for passing through trees and similar places the continuance of a wet spell cannot injure the insulation of the line; at the same time the hard, horn-like character of the insulation is a great protection against abrasion.

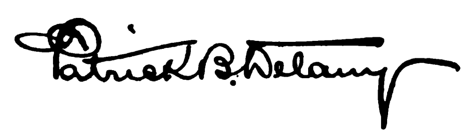
The question of connecting cities by underground telegraph circuits has long been a mooted point and it is a fact, that, lately, some of the principal railway companies have been investigating the feasibility of connecting the cities to which they run by cables laid in or on the roadbed of their systems. If it were not for the high cost of india rubber and the weak points of the ordinary fibre-covered wires it is possible that a cable system might have been adopted and permanent communication between cities assured, or, what is of greater importance to them, the integrity of their block system maintained. Cables can now be made of the new "Ideal" wire, as it has been named, at a cost only slightly exceeding the ordinary fibre insulations, the integrity of which can be guaranteed and any damage to which, mechanical or otherwise, will be confined to the cores directly receiving it.

Arguments have been made against the practicability of working underground cables of such length at a speed sufficiently high to insure the commercial success of the undertaking. In reply to these arguments I will make the assertion, based on 20 years' experience of the practical working of Atlantic cables, that underground cables can be constructed 100 to 300 miles in length, over which working speeds of 550 and 250 words per minute, respectively, can be maintained by means of apparatus which is in constant daily use and if such lengths of cable were laid and experimented with I am confident that in a very short time the speed would be greatly increased. These figures, I think, will not be found much below the practical speed of land lines of equal length. One great point to be borne in mind is that the circuits are clear from all foreign interferences such as leaks, swings and crosses, which, more than anything else tend to reduce the average speed of Morse working on land lines to a comparatively low figure and to raise the number of errors to a high one.

The "Ideal" wire is also made practically fireproof by a special process and it is being tested by independent parties to determine its power of resisting disruptive discharges, the peculiar character of the wire and preliminary tests leading them to anticipate a very high figure.

SELF-INDUCTION AS A REMEDY FOR STATIC DISCHARGE.

BY



While the very interesting paper on "Ocean Telephony" read by Prof. S. P. Thompson at the Electrical Congress in Chicago is still fresh in the minds of those who heard it or have since read it, I deem it opportune to give the results of considerable practical experience while assisting Mr. Edison about twenty years ago in the attempt to overcome the retarding effect of static capacity by self-induction, for the purpose of increasing the speed of telegraphic transmission over an overhead wire about 250 miles in length and having a resistance of about seven ohms per mile.

The line was, I think, the first "compound" wire used in this country. It comprised a steel core with copper wrapping wound on spirally. The wrapping and core were imperfectly joined by some sort of tinning. I presume the static capacity of this wire was about the same as the ordinary telegraph wire of those days, although it was of somewhat smaller gauge and was the only wire on the poles. It extended from New York to Washington and was built for the purpose of perfecting and demonstrating a system of machine telegraphy, chemical paper being used for receiving.

The results obtained at the outset were disappointing, owing to the "tailing" effect caused by the static charge. The speed for clear signals did not exceed about 200 words per minute. With any hand system of operation of course the effect of so small a charge over such a line could not be noticed, but with high speeds every mile of line, even though it be on poles, has a visible effect on the signals, provided the speed is sufficiently high.

I cannot speak with great certainty after this lapse of time, but my recollection is that artificial remedies for the effects of static discharge were suggested by a rain storm. It was soon found that in wet weather the speed could be doubled without affecting the clearness of the signals. As rainy weather could not be relied upon the only thing to do was to introduce artificial leaks at different points along the line. In some instances electromagnets were used instead of plain differential resistance and it did not take

long to find out that the electromagnetic leaks gave much better results than any other. In an extension of these experiments from New York to Charleston, S. C., a distance of about 800 miles, water and other liquid leaks were introduced about every 50 miles along the line, but it is now easy to understand how they were rendered useless by polarization. They were abandoned after a short trial and electromagnetic leaks were made a permanent part of the working outfit at New York and Washington. None were used at intermediate points except perhaps, at Philadelphia, as they could not be controlled. In rainy weather the natural leakage added to the artificial would waste too much of the current.

So far as I am aware, this was the first time, in this country at all events, that self-induction was recognized as a remedy for static discharge. When the wire was thoroughly wet throughout its entire length so that an evenly distributed leakage was established, the speed of signaling could be raised beyond the best speed obtainable by the use of the self-induction remedy in dry weather. About 700 words per minute were obtained under such conditions between New York and Washington. On these wet days, however, higher E. M. F. was necessary, not so much for the chemical paper signals as for the Morse system used for acknowledgments, etc., it being quite impossible to receive anything by relay with a current sufficient for perfect signaling on the paper. Had it been possible to distribute the self-induction throughout the line as Prof. Thompson proposes, instead of in spots, much better results would surely have been obtained, but there was no way suggested for doing this at that time, and even now it seems to be considered mechanically or, at least commercially, impracticable.

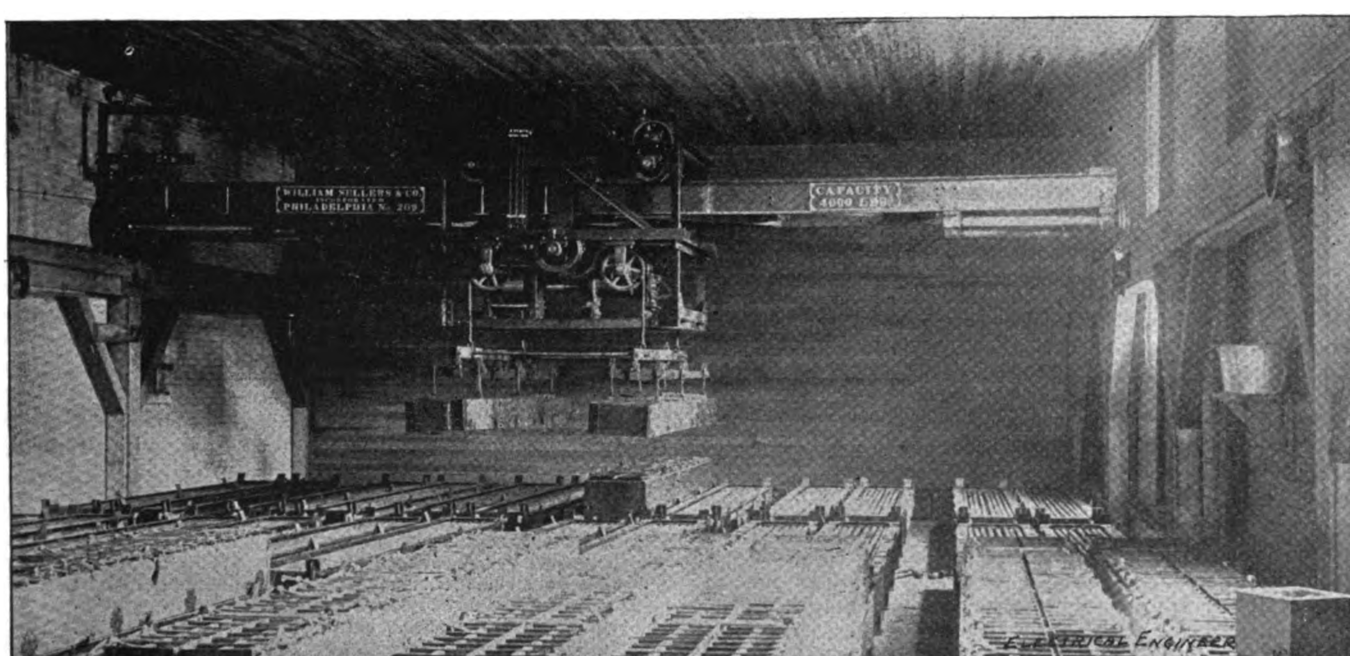
I have always believed that fast signaling over long cables could be brought about by simply decreasing both the conductor and insulation resistance—a good conductor with poor insulation. This view was given in a paper on "Cable Telegraphy" read by me before the Franklin Institute in March, 1889, and published in the Institute's *Journal* in July of that year, as the following quotation will show. "It would be much better if the insulation of the cable was less perfect. It could be operated much faster. My own opinion is that the great need in cable telegraphy is bad insulation—or a *good bad* insulating material—something that will not go from bad to worse under the action of the current."

In one of a series of Papers on "Electromagnetic Theory" by Oliver Heaviside published in the London *Electrician* Sept. 18, 1893, that distinguished authority, referring to the subject of cable telegraphy, says: "Thus a proper Atlantic cable suitable for rapid signaling should not have high insulation resistance but the very lowest possible consistent with getting enough current through to work with." I think Mr. Heaviside is right.

ELECTRIC RAILWAY DEPARTMENT.

THE WADDELL-ENTZ STORAGE BATTERY CARS ON THE SECOND AVENUE RAILROAD, NEW YORK.

In our issue of April 26, 1893, we gave an account of the inauguration of electric storage battery traction on the Second avenue surface road in New York, between 92nd and 129th streets. The cars are equipped with the Waddell-Entz motors and copper-steel, alkaline accumulators, which have already been fully described in THE ELECTRICAL ENGINEER. The first cars were put on the road in May of this year and the total mileage to Oct. 15, has been 40,000 car miles. Since August 1, the cars have been run on five minutes headway without interruption from 6.55 a. m. to 6.15 p. m. every day, which gives a mileage of four hundred miles per day. As showing the reliability of the service rendered, it is sufficient to state that during the entire operation of the storage cars, traffic on the road has never been delayed for one instant, and the cars have not missed one-half per cent. of their schedule trips during this time.

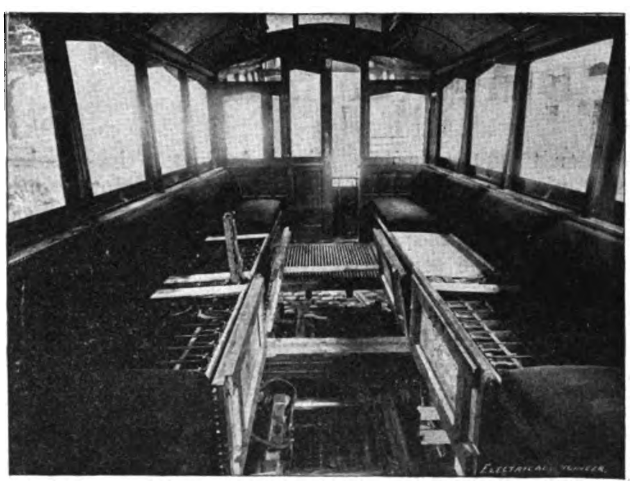


TRAVELING CRANE FOR SHIFTING WADDELL-ENTZ STORAGE BATTERIES, SECOND AVENUE RAILROAD, NEW YORK.

The charging arrangement consists primarily of a boiler and engine plant, the latter consisting of two "Ideal" Harris-

burg engines directly connected to two Waddell-Entz 50 k. w. multipolar machines. The batteries are all on the upper floor, which is equipped with a very compact switchboard. During charge the cells rest upon coils through which steam is circulated and which heats the cells. This not only decreases their internal resistance but keeps up the circulation of the electrolyte and thus insures uniform action over the whole cell.

Each car is equipped with 144 cells, which are grouped in two trays. The handling of these trays is accomplished in a most beautiful manner by an overhead traveling crane, shown in the accompanying engraving, page 387. With the aid of this crane the two trays are both lifted and at once transferred to the end of the charging floor and lowered directly onto the shifting table. The latter is equipped for four trays and as the car enters the station with its battery discharged it backs up against the shifting table; the panels at the ends of the car corresponding to the space below the seats is removed, and the cells pulled out from under the seats directly onto the shifting table. The car is then, by a single turn of a shifting jack, moved 18 inches sidewise so that it comes in direct line with the freshly charged cells which have been lowered from above. These are then shoved into the space under the seats and the end panels closed. The pulling out and shoving in of the batteries is accomplished by means of an



The Waddell-Entz Storage Car.

electric motor operated by a set of levers, the whole operation from the time the car enters the stable until it leaves with the fresh set of batteries occupying four minutes.

Such a record, as cited above, of continuous operation without interruption of traffic of any sort, could, of course, only be accomplished by observing the strictest care, both in the handling and operation of the cells. As illustrating this point it may be remarked that every other day the potential of every cell is taken and recorded, and those showing any symptoms of irregular action are at once removed and replaced by fresh ones. In order to insure thorough regularity of action in the cells each battery is completely discharged once a week. This does not in itself entail any appreciable loss, as these discharging cells furnish current for the lighting of the stables, the operation of the crane, the motor of the shifting table, etc., which are in constant use.

The expenses for running the road may be divided under the following heads:

Operating Force:—This includes two engineers at $18 per week each; two men at the switchboard, one at $15, and one at $16 per week; one man to operate the shifting table and one man on the battery floor to hook the batteries on to the crane, etc., both of whom are paid $9 per week. This makes a total of $85 per week for the operating force, and, on the basis of 400 car miles per day, is 3.54 cents per car mile for this item of expense.

Battery Men:—In addition to the above there are two battery men at $9 per week each, to give the battery what attention it needs, which figures up at .75 cent per car.

Repair Shop Force:—This consists of two men to repair damages to motors, gears, cars, etc., at $9 per week each, making an additional cost of .75 cent per car mile.

Coal:—For all power, including crane and shifting table, items taken directly from coal burnt, all coal going into boilers being weighed each day; the coal consumed, 15.8 tons per week, costing $3.42 per ton, which brings this item to 2.24 cents per car mile.

Oil, Waste and Water, as shown by the books, figure at 0.2 cent per car mile.

The renewals of motors, gears, frames, etc., has involved an expense of $120 for 40,000 car miles or 0.3 cent per car mile.

Finally we must add the depreciation of the batteries and this is figured on the basis of replacing all damaged cells and putting the batteries in as good condition as new; this item amounts to 1.54 per car mile.

Taking all these figures together, as shown by the books of the company, we find a total of 9.32 cents per car mile for the cost of electric power. These figures are tabulated below for more convenient inspection.

Operating force..............	3.54	cents per car mile.
Battery men..................	.75	" "
Repair shop force............	.75	" "
Coal.........................	2.24	" "
Oil, waste and water.........	.20	" "
Renewals of motors, gears, etc..	.30	" "
Depreciation of batteries.......	1.54	" "
	9.32	" "

It will be understood that the present battery shifting apparatus, including the crane and shifting table, changes the batteries in four minutes, though this time could be easily reduced one-half, if not more, if necessary. But up to the present the batteries have not required to be changed oftener than at intervals of 10 minutes, since only every other car is brought in for battery change.

As the running time is arranged at present, each car runs three hours with one change of battery, but with the present equipment for handling the batteries, 18 cars, or three times the present number, could be handled, working under the present headway.

The cost per car as given above may appear somewhat high in comparison with figures that have been published heretofore relating to roads operating under the trolley system, but it goes without saying that with an increased number of cars the majority of the items given above would be materially reduced, and an estimate, made on such a basis, may not be without interest. Taking the operating plant as it stands to-day at the Second Avenue car stables and running it up to its full capacity, it would be able to handle 18 cars, running 12 hours, and covering 80 miles per day per car, which would give a total of 1,440 car miles per day. This would involve the following operating force and other expenses:

Operating Force, increased by 3 extra men, 1 on shifting table, 1 on crane and 1 on battery, increasing present pay roll by 33 per cent..........	1.31	cents per car mile.
Fuel, on basis of 30 lbs. water per h. p. hour. Boilers, same efficiency as at present, also a saving of 16⅔ per cent. by running greater number of cars and longer hours..................	1.15	" " " "
Battery Men, double present force	.42	" " " "
Repair Shop Force, double present force..........................	.42	" " " "
Oil, Waste and Water..........	.15	" " " "
Renewals on Motors, Gear, etc...	.30	" " " "
Depreciation of Batteries........	1.54	" " " "
	5.29	" " " "

Here it will be seen the depreciation of batteries, the renewals on motors, gears, etc., have been taken at the

' The figure is intended merely to show the principle—the details admit of great modifications and improvements over those shown.

It makes little or no difference in the compensating action of the batteries whether they be coupled to the circuit of the station or at sub-stations located at various points at a distance from the station. There would result from the use of sub-stations a greater uniformity of potential over the whole system, and a saving in copper; but one must offset against this the extra cost of the space, the extra attendance and expense of sub-stations. They may be warranted, for this reason, only in very large systems covering large and relatively distant territory; also in inter-urban lines.

The investigation and study by your committee of the facts and data bearing on this subject as outlined herein above, would seem to warrant the following conclusions:

1. Great progress has been made in Europe during the last two or three years in the manufacture and perfection of storage batteries suited for central station purposes.

2. Storage batteries have been introduced in a large number of electric lighting central stations on a large commercial working scale, as factors of reserve and regulation, with a view to securing economy of initial cost and cost of operation, with satisfactory financial results, as a general rule which has few, if any, exceptions, so far as your committee could ascertain.

3. The benefits derived from lighting central stations from the judicious use of storage batteries are so valuable in individual cases, that the possibility of attaining like benefits, even to lower degrees, in railway power stations would justify the investigation of their use by actual experiment where this can be done under favorable conditions.

4. While the conditions differ, and are essentially more severe, in railway power stations, there is no reason apparent why storage batteries may not be used successfully and advantageously, for the purpose of securing greater uniformity of potential at the station or on the line, or of promoting and improving the efficiency of the plant.

5. Even assuming the highest values for initial cost and depreciation of the storage batteries, the indications point to the possibility of realizing a gain in economy in all stations operating 200 cars and less, when coal is worth $2.00 per ton and over, while the economy will be much greater should the initial cost and depreciation prove actually lower in practice. Advantages are also secured which though not effecting economy directly, do so indirectly by affording additional convenience in operation.

6. The indications are that in some cases, a power plant could be built and operated at less cost by using storage batteries than without.

7. The capacity of an existing plant can probably in most cases be increased more cheaply by adding storage batteries than by adding more generating machinery; while at the same time the cost of operation will be reduced.

8. The question whether the storage batteries are expedient and practicable, and to what extent, or any particular case, should be, and can only be in the present state of our knowledge be determined for each case individually, by a careful analysis of the facts and conditions involved, by a competent engineer.

9. Practical experience in a certain number of stations alone can lead to definite rules or indications in regard to the best size of the battery, the best methods of regulation, the most favorable conditions of use, and like questions.

10. Perfection in the details of the use of storage batteries in railway plants will be the result of a certain evolution, or series of improvements the same as in other details of the equipment of a plant.

TRACTION AND STREET RAILWAY TRUCKS.[1]

BY ELMER A. SPERRY.

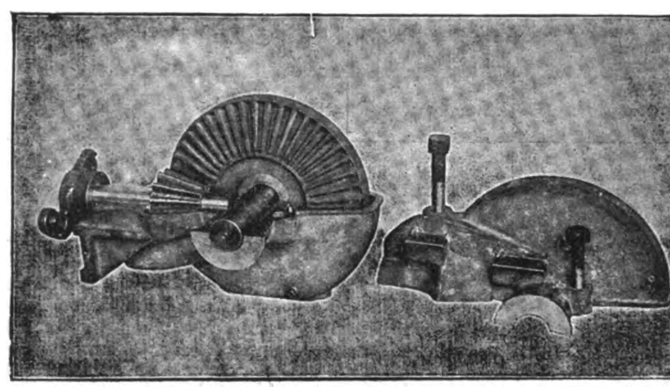
In the popular mind the laws governing traction or adhesion are entirely divorced from those governing friction. This view is not correct. The adhesion between the wheel and rail is really friction of quiescence. In studying the laws governing both friction of quiescence and friction of motion one is struck with a peculiarity in the curves, notably so when metallic substances are undergoing examination. The characteristic relates especially to a remarkable drop constituting practically a vertical line between the readings taken before and after slipping commences between the metallic substances under test. The author gives a curve taken as between a rail and wheel supporting about 3,200 pounds. The curve shows that the characteristic is by no means one of gradual or proportionate transition from a state of quiescence to that of motion, but on the contrary, a breaking away with a wonderful suddenness of drop from high values to those which are very low.

Without recounting other experiments which have forced me to the following deduction, I will state that, in my opinion, what we know as friction of quiescence or adhesion between a wheel and a rail consists essentially of molecular gearing, the teeth of which, though minute, are as positively in mesh as those of the regularly organized gear. These I have found to be maximum when the substances are alike, under these conditions the afore-named molecules or irregularities probably being very similar as to dimensions. The curve in question is drawn to scale, and graphically portrays the extremely low values in terms of traction or drawbar pull, upon the dynamometer of the slipping wheel, as compared with the wheel rolling upon the track without slip. This curve was obtained in determining by trial the grade at which forwardly revolving slipping wheels would just balance the tendency of the weighted car to slide down the grade. The curve shows the instant of starting to slip to be the critical point, and the problem is pre-eminently one of preventing the wheels in question from starting to slip. How can this be best accomplished?

The writer has made a number of tests which may be of interest in this connection, and which show that there is a possibility of improvement upon methods which we at present accept as standard. The oldest method of accomplishing this purpose has been to couple all the drivers for absolute harmony and uniformity of movement, so that the tendency to slip of one driver will be held back by all the others instead of by its mate only. The question being, Do we find in practice the coupling of the wheels in this way to accomplish the desired result? Does it in any way increase the traction?

Experiments have been made to determine this question, including a bi-axled equipment of the ordinary kind with an independent motor for each axle, and also equipment consists of four, six, and as high as eight separate drivers locked together and compelled to revolve in unison, being supplied with a single motor or source of power. I have found the method employed in coupling the wheels to seriously affect the traction appearing as drawbar pull.

As to the street car truck, the flexibility necessary argues the employment of belting or rope transmission, which easily and naturally permits of such flexibility. No form of friction drive or



SPERRY BEVEL GEAR FOR RAILWAY MOTORS.

friction gearing is admissible for this work. The chain drive was the first to be employed in this country, but was early abandoned on account of noise, excessive wear and journal strains, together with the impossibility of keeping it anything like adequately lubricated.

As to gearing between the axles, the bevel gear presents by far the simplest solution. This form of gearing, however, has been looked upon as wasteful of the power transmitted. This criticism is probably just in some power transmissions employing this gearing. The question is, How much more power does a bevel gear and pinion absorb than a spur gear and pinion in transmitting the same amount of power, with the conditions identical? The author then described an apparatus designed for testing this feature, with which an exhaustive series of tests has been made. The spur gears were 4¼ inches face, cut in steel, finished on an Eberhardt machine with Brown & Sharp cutters, running in an oil-tight casing in which three-quarters of a gallon of oil was placed. They were accurately placed on pitch line, and run very easily and smoothly. The bevel gears used were turned out by the Walker Manufacturing Company, the test in question being used to ascertain the best shape of teeth for the work. The bevel gear was 5¼ inches face, the teeth were uncut, and of coarse pitch, cast very smooth and double shrouded, the pinion being cast steel, uncut, and five inches face. The conditions under which these tests were made were as nearly alike as it was possible to make them, and at the same time the transmissions were worked under the same conditions that obtain when mounted on a street car truck. Numerous curves were plotted, showing the total losses from the electrical terminals of the motor to the dynamometer, showing gear losses, losses resulting from shoulder and journal strains produced by the gearing, and all the bearings in each test through the entire range

1. Abstract of a Paper read before the American Street Railway Association, Milwaukee, Oct. 18, 1893.

from starting to about 60 h. p. input. The curves show that under practical working conditions, when the bevel gear is properly made, the losses are almost identical with spur gear; the the small difference, viz., 1.74 per cent., in favor of the cut gear, probably being due to the fact that the surfaces were somewhat rougher in the cast as compared with the cut gear. The great care exercised in these tests, and the clearness of the results certainly speak volumes in favor of the bevel gear transmission, and constitute the first comparative tests of large transmissions under heavy strains which, to the knowledge of the writer, have been made.

Another feature bearing directly upon the all important question of traction is that of axially mounted masses. All weights of magnitude should be spring-supported. In this connection it has not before been pointed out that it is largely immaterial whether the axle is compelled to carry much or little of the weight of the mass so long as such mass is solidly and unyieldingly attached thereto, inasmuch as the axle is compelled to follow the laws of falling bodies controlled by the weight and enertia of the mass as a whole.

Referring now to the tests, a grade was built consisting of 45 pound T rails rising from a spur of level track, giving a mean grade of the two rails of 12.4 per cent. Upon this grade was run, first, a double motor equipment weighing 17,985 lbs. A dynamometer was attached to the drawbar and back to the track in such a line as not to either lift the car or drag the rear end downward in the test. Current was then applied through a variable resistance, gradually allowing the car to strain upon the dynamometer until finally the wheels slipped. Care was especially exercised on the point of gradual application of the strain so as to eliminate all elements of enertia or lunging forward upon the dynamometer; after slipping had commenced it was observed that the car would slide in each instance to the bottom of the grade. The following table gives the mean of four sets of readings:

INDEPENDENT AXLE, TWO MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing on 12.44 % grade.
Weight of equipment, 17,985 lbs.

Group of Tests.	Average Amperes.	Average Drawbar Pull.	Ratio Drawbar Pull to Weight.
1	200	1,625 lbs.	9 per cent.
2	230	2,250 "	12.5 "
3	240	2,150 "	12 "
4	230	2,075 "	11 "

This car was run off the grade and replaced with one in which all the wheels were compelled to revolve in unison, but of much lighter weight, viz., 12,685 lbs. The dynamometer was attached in the same way and the same rheostat and source of current was used as in the previous experiment, the axles in this equipment being coupled by the bevel gears shown and described in connection with the gear tests above referred to. The following table gives the mean of five sets of readings taken from this car:

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing upon 12.44 per cent. grade.
Weight of equipment, 12,685 lbs.

Group of Tests.	Average Amperes.	Average Drawbar Pull.	Ratio Drawbar Pull to Weight.
1	200	3,125 lbs.	24 per cent.
2	240	3,750 "	30 "
3	230	4,075 "	32 "
4	230	4,500 "	35 "
5	200	4,375 "	34.4 "

The same operator applied current to the car in both tests, and every condition of electrical pressure, track and water, remained identical throughout.

The car was then run off the track and the rails blocked, one rail being 12⅝ inches rise in ten feet, the other being 17.2 inches, making a men of 14.92 inches rise in ten feet, equaling a grade of 12.44 per cent., giving a warp of considerable magnitude to the roadbed. The warping of the roadbed would at once develop any rigidity introduced into the truck by the coupling, and show up very materially in the ratio of drawbar pull to the current absorbed if the equipment or any other part was bound, unduly strained, or working under any but perfectly normal conditions. The following table shows the readings taken, and is conclusive as to the perfect freedom of the truck while working in this warped and highly distorted position. This great difference in favor of coupled drivers shows a percentage of 35 as compared with 12.5 of the total weight appearing as actual pull at the drawbar under the conditions named:

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing upon warped track.
Right rail..............................14.33 per cent. grade.
Left rail..............................10.58 " "

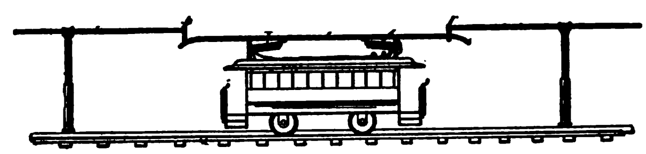
Weight of equipment, 12,685 lbs.

Group of Tests.	Average Amperes.	Average Drawbar Pull.
1	230	4,425 lbs.
2	220	4,375 "
3	200	4,150 "
4	230	4,375 "

While working upon a level, and especially in damp weather with a slimy rail, almost the same advantage in traction will be found to exist as is here given for coupled wheels, provided always the mechanism used in coupling does not interfere in the least with the flexibility of the truck.

THE GREEN CURRENT SUPPLY SYSTEM FOR RAILWAYS.

A PATENT has been issued to the late George F. Green, of Kalamazoo, Mich., for an electric railway, employing a series of upright posts at the side of the track to which current is led by a



THE GREEN CURRENT SUPPLY SYSTEM FOR RAILWAYS.

feeder laid in an underground conduit. The posts have arms extending over the track above the roofs of the cars and provided with contact brushes connected with the feeder but carefully insulated from the post. A contact shoe on the car is carried above the roof and extends a considerable distance beyond its ends so that it is always in contact with at least one set of brushes carried by the stationary posts.

To provide for the change of direction due to curves, the shoe is made in jointed sections and the extending arms of the posts are so constructed that they may yield in any direction. Electromagnets are provided whose cores are fixed upon the shoe and whose coils are excited by the motor circuit on the turning of a switch. These operate to attract the shoe and the brushes toward one another.

The accompanying diagram will give a clear idea of the system.

MISPLACED FAITH IN BRAKES.

THE Philadelphia *Ledger* says: Of the millions of people carried to Chicago, relatively few have suffered from accidents, and, notwithstanding the terrible loss of life at Jackson, Mich., the record, as a whole, is one that reflects credit on railroad administration. The air brake, which, when in order, helps to prevent accidents, seems to have been responsible for the Jackson accident. The engineer, relying upon his brakes, dashed up to a station where a train was standing, and, as his brakes refused to work, a collision was inevitable. The air brakes, as a rule, protect the passengers, but they bring with them a new source of danger in the high speed at which trains are run because of faith in the brakes.

A GAS ENGINE AND DYNAMO COMBINATION.

A GAS ENGINE for dynamo service has been in operation at the station of the Waukesha (Ill.) Electric Light Company for over a year, says the *Engineering Record*. It is a 100 h. p. two cylinder, Otto engine, with an electric igniter and an unusually heavy fly-wheel and pulley, the regularity of motion being increased by the use of a heavy balance wheel carried on a jack shaft. Measurements of the consumption of gas have been made several times by the manager, George A. Farwell, who reports that in a ten hour run driving 53 arc lights of 2,000 c. p., on a 9½ mile circuit, 10,290 cubic feet were burned, equal to 20.6 cubic feet of gas per lamp, per hour. In another test, 36 arc lights and 300 incandescent lamps were run on 1,400 feet an hour, and in still another test 36 arc lights and 425 incandescent lamps were run on 1,600 feet an hour.

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THE STORAGE BATTERY OUTLOOK.

THE history of the storage battery in this country presents phases of such anomalous character that it can be compared to that of no other electrical apparatus of like importance which has yet made its appearance. The readiness with which Americans are known to take up and bring into practical shape and use every invention and apparatus giving promise of commercial success seems, in this instance, to have been entirely wanting with the result that to-day America makes perhaps the poorest showing in the application of storage batteries of any country of similar size and importance. To analyze the causes which have led to this, in many ways to be deplored result, would lead us too far; but we think they can be summarized in the statement that the proverbial American impatience for results and inadequate attention to details in the early stages of the introduction of the storage battery will account for many of the failures recorded. The excellent results which have within the last few years been attained in Europe with it have, we are glad to say, again forced the storage battery on the attention of our own electrical engineers, and we have of late discerned a reviving, and we hope an increasing, faith in the capabilities of the accummulator when properly applied. In central station practice the economy to be derived from operating engines at full load for a definite period, which the storage battery makes possible, appears to be now no longer a matter of doubt, judging by the results obtained abroad; and the recent trial of a like method of station operation in New York City corroborates this European experience.

But what is shown to be so eminently conducive to economy in lighting work ought to be not less so when applied to electric railway operation. Much of the discussion which has been had on the management of street railways has related to the most economical method of power equipment and hence it is fair to assume that this item of railway expense is constantly before the eyes of street railway managers. The office which the storage battery is capable of performing when applied to existing trolley roads is admirably set forth in the paper by Mr. C. O. Mailloux, to which we alluded last week, and the concluding portion of which appears in this week's issue. With the usual load factor of railway power plants, and the enormous power fluctuations to which they are subjected, there would appear to be here a field for the storage battery, more extended even than in electric light stations.

But we must not lose sight of the direct application of the storage battery in railway work,—the storage battery car. While the trolley system is unquestionably strongly intrenched, and at the time of its introduction confessedly presented the only available and practical method for this country, no one will deny that it has its shortcomings; we may go so far as to say that street railway managers themselves would welcome a system which, in the first place, would dispense with the overhead system of conductors and all the troubles to which they are subject, and, in the second place, would make each car a self-propelling unit, independent of any other factor in the operation of the road.

The sporadic attempts which have been made to demonstrate the feasibility of storage battery traction have not, we are sorry to say, proved convincing to the large majority of street railway managers, who are perhaps among the most conservative of business men to be found anywhere, and rightly so. Quite recently, however, the subject has again been taken up with energy and in a manner which bids fair to demonstrate that the storage battery, applied directly to the car, can, under proper local conditions, hold its own against any other method of traction. We base this view upon the very systematic trial which is now being carried out by the Waddell-Entz Company on the Second avenue surface road in New York, and which has extended over a sufficient lapse of time to enable a fair estimate to be formed of what the system is capable of accomplishing.

The result obtained on the Second avenue line has shown that in practicability and reliability, storage battery traction can be depended upon to fill the needs of the most exacting conditions; but, it will be asked, What does it cost? On this point we are enabled, through the courtesy of the Waddell-Entz Company, to give the cost of operation of their storage battery cars on the Second avenue road as made up directly from the books of the company. The figures of the actual cost, under the present conditions, with six cars in operation, show that the expense for power, including everything which properly belongs under that head, amounts to 9.32 cents per car mile. This figure, of course, exceeds that which may be attained with the trolley system, but the cost for the same items of expense when figured on the basis of 18 cars would compare far more favorably with that of the trolley. If in addition we take into consideration the cost of overhead construction and its maintenance, the high efficiency at which the engines can be operated, and the other advantages accruing from having the entire operating force constantly under the eye of the superintendent, this disparity is still further lessened. The frankness of the Waddell-Entz Company in thus making public figures which could be obtained in no other way, is to be most heartily commended, and we sincerely hope that their present successful attempt on the Second avenue road may be the forerunner of a considerable application of the storage battery to traction work in the United States. It may take some time yet to heal fully the wounds of the past, but with a better understanding of the nature and capabilities of the storage battery America may yet turn its early storage battery experience to good advantage.

WORLD'S FAIR DEPARTMENT.

THE CARPENTIER EXHIBIT AT THE WORLD'S FAIR.

THE well-known constructor, M. J. Carpentier, of Paris, has made a very complete and instructive exhibit of electrical measuring and demonstration apparatus in the French Section in Electricity Building. Among them we find a resistance box with 60 coils arranged in tens with 10 proportional coils forming a Wheatstone bridge. In another box, Fig. 1, there are 36 coils with eight proportional coils also forming a Wheatstone bridge set. In these two sets in which the coils are arranged by tens, the keys are reduced to the smallest number, their manipulation being easy and without influence on their respective positions.

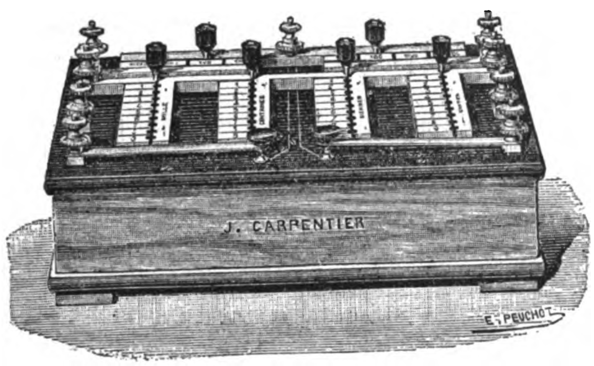


FIG. 1.

In this class of apparatus also we find a box with 16 coils giving 11,110 ohms and a circular rheostat arranged in sets of four tens with Wheatstone bridge proportional coils. In this type the resistances composing the proportional arms are specially grouped so as to allow rapid change of proportionality. As will be seen in Fig. 2, the plugs are replaced by a sliding contact arm so that very rapid work can be done. Fig. 3 represents a large model divided wire Wheatstone bridge. This apparatus has been subjected to special study by the French Electrical Units Commission according to the method employed by M. Mascart for the comparison of standards of resistance. It

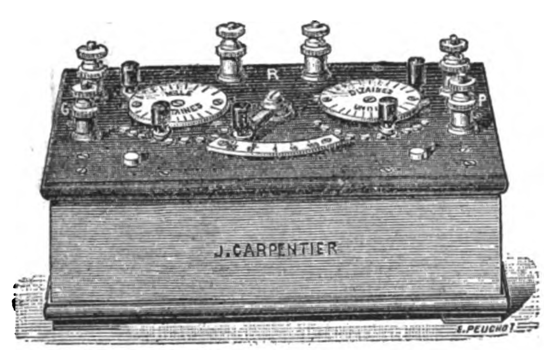


FIG. 2.

has been employed for comparing the original standard of the legal ohm constructed at the International Bureau of Weights and Measures, by M. R. Benoît, for the Minister of Posts and Telegraphs. Fig. 4 represents a copy of the standard legal ohm and there are also shown secondary standards of the legal ohm, a legal ohm of German silver, a box containing 10 coils of 1 ohm each and one containing

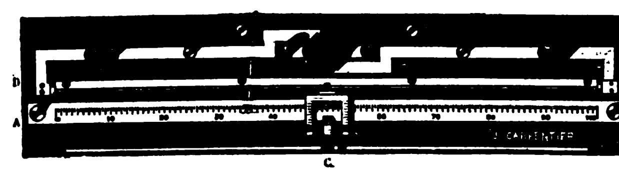


FIG. 3.

10 coils of 1,000 ohms each, giving a total of one megohm. All the resistance coils of this apparatus are constructed on a new system and all are provided individually with small rheostats which admit of their being given their final adjustment with the greatest accuracy.

The galvanometric apparatus exhibit is particularly complete. Among this class we note a Deprez-d'Arsonval aperiodic mirror galvanometer on an ebonite base for physical cabinets; also a differential aperiodic mirror galvanometer of the Deprez-d'Arsonval type on an elaborate base, and an aperiodic galvanometer of the same type with its coil frame mounted on pivots and having spiral springs as the opposing force. These galvanometers are not influenced by stray magnetic fields. They are thoroughly dead beat and take up their position of equilibrium without vibration. We also note a Thomson galvanometer of the Carpentier type. In this galvanometer the coils can be taken apart with the greatest ease and replaced by others of different resistance. The astatic suspension is very accessible and

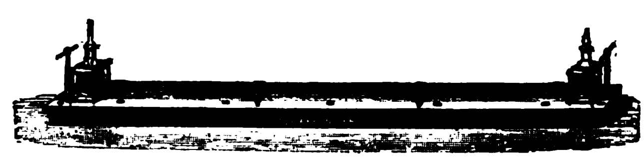


FIG. 4.

in case of accident can be easily repaired and replaced. It is accompanied by a $\frac{1}{9}$, a $\frac{1}{99}$ and a $\frac{1}{999}$ shunt.

Fig. 5 represents the Carpentier aperiodic mirror electrometer. The movable armature of this apparatus consists of a rectangular magnetic frame completely closed. The fixed armatures are the parts of two concentric cylinders. A U-shaped magnet surrounds the entire electrostatic system, its object being to create a magnetic field, the lines of force of which are cut by the moving frame, and thus make the system completely aperiodic. This electrometer is, of course, intended for workshop laboratories. When employed without a charging battery by the idiostatic method it gives a deflection of nearly 250 millimetres with a difference of potential of 75 volts, and with a charging battery of 100 volts, a deflection of 10 millimetres per volt is obtained.

The aperiodic Carpentier electrometer, with needle and dial, shown in Fig. 6, is based on the same principle as the preceding instrument. This electrometer is adapted for measuring the high potentials now largely employed in central stations. Its movable coil carries a needle passing over a dial, its graduation in volts being done empirically. The instruments are built to read to the following voltages:

600 to 1,100, 700 to 1,500, 800 to 2,000, 1,000 to 2,500 and 1,400 to 3,000. The advantages of electrometers over other types of measuring apparatus for large differences of potential are obvious; unlike the usual electromagnetic instruments they draw no current from the circuit, and, in consequence, are not subject to heating errors, which frequently destroy the value of the other types of instrument. Among this class of instruments, also, we find a Mascart electrometer of the Thomson type, modified by M. Mascart in order to increase its sensitiveness.

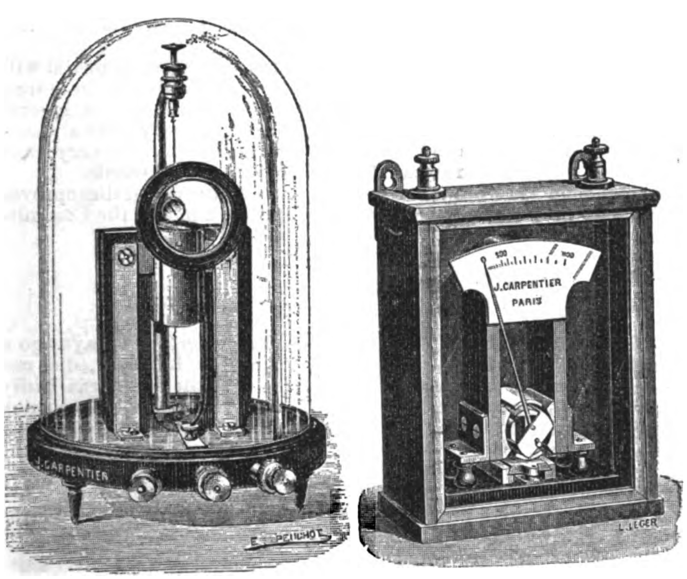
There is also shown an absolute electrodynamometer after the plan suggested by M. Pellat in 1886. The determinations of the quantities which enter into the expression of its constant A have been effected by the International Bureau of Weights and Measures, and the equation is as follows:

$$A = \sqrt{\frac{l\,e}{\pi^2\,N\,n\,(l-a)\,d^2}},$$

in which l equals the length of the lever arm; $e =$ the pitch of the convolutions of the fixed coil; N, the number of layers of wire in the fixed coil; n, the number on convolutions in the movable coil; d, diameter of the movable coil, and a, a coefficient of correction.

The current strength, C, is given in C. G. S. electromagnetic units by the formula $C = A\sqrt{\frac{g}{p}}$, where g stands for gravity and p the mass in grammes. The balance is sensitive to $\frac{1}{10}$ of a milligramme; a current of 0.3 ampere is equilibrated at Paris by a weight of 0.418 gramme. If we suppose that errors committed in the determination of the factors of the constant to be added numerically, the total error resulting therefrom in the absolute value of the current strength would not exceed $\frac{1}{2000}$.

The Pellat ampere standards are graduated by comparing them with the absolute electrodynamometer, and they can therefore be used for the same purposes as the latter.



FIGS. 5 AND 6.

The balance is sensitive to $\frac{1}{10}$ of a milligramme; a current of 0.3 ampere is equilibrated by about 1.5 gramme. The engraving, Fig. 7, shows the instrument in perspective. These ampere standards are designed to measure directly currents varying between 0.1 and 0.5 ampere.

An ampere balance admits of the following: 1. The standardizing of all other apparatus designed to measure current strength. 2. Joined to a standard of resistance, the measuring of E. M. F.'s in absolute values. 3. Joined to a tangent galvanometer the measuring of the horizontal component of the earth's magnetism. Besides the instruments designed for laboratory purposes, M. Carpentier exhibits a variety of ammeters and voltmeters with or without magnets, intended for workshop and central station work, on the Deprez-d'Arsonval principle.

Among the other apparatus shown are the various kinds of magnetometers devised by M. Mascart for the study of terrestial magnetism such as the unifilar magnetometer (for horizontal component), the bifilar magnetometer (for

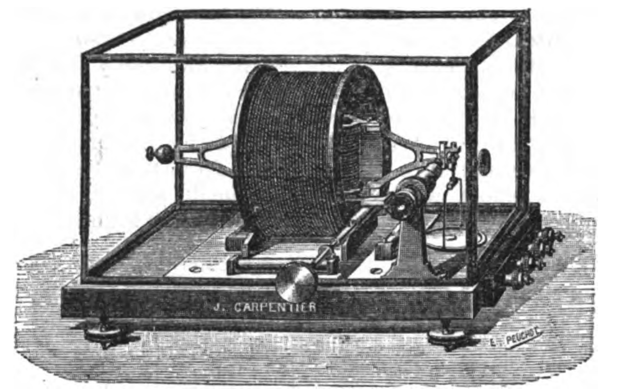


FIG. 7.

variations in intensity), magnetic balance (variation in intensity, vertical component), and reading telescope for observing the magnetic apparatus and the graduated scale with variable curvature.

We also note a number of standard condensers subdivided from .1 to 1 and from .001 to 1 microfarad; also condensers composed of plates of silvered mica and occupying extremely small space.

Finally, the exhibit contains a variety of accessory apparatus such as discharge, reversing and short circuiting keys, and scientific apparatus, including a Ruhmkorff coil with Foucault interrupter, Thomson replenisher and idiostatic gauge, etc.

"LIGHTS OUT" ON OCT. 31.

It has finally, and very wisely, been decided this week to close the World's Fair on Oct. 31, by which time the Exposition authorities will have the returns for about 21,000,000 paid admissions. As one looks around on the beautiful buildings of the great White City, one realizes with what a pang the designers and builders must lay plans for the destruction of their own fair work. It is true that much of the material is sham, but it is so frankly and avowedly, while the beauty is not sham but a reality that has entered into and refreshed the lives of all whose eyes have seen it, whether in the grim early days of May, when the elements themselves made war on the city or now when in a mellow Indian Summer of rare softness some 300,000 people are crowding all the walks and waters, each day of the last week.

It must all go, however, leaving but few wracks behind, and although the toil of demolition does not begin until Oct. 31—a week from this time of writing—a great many of the exhibitors are making quiet preparations to pull down and flit. Director-General Burnham has pointed out that very soon all the water and sewer connections are likely to be frozen up, and that the Westinghouse contract for all incandescent lights, including all exhibitors and concessionaires' arc lights expires on November 1. After that time such visitors as come in will find the grounds open from 8 a. m. until 6 p. m., but the buildings will only be open till 4 p. m. All the night shows will be discontinued, and while some electric lights will burn for a while in the Administration and Woman's Buildings and possibly also in Electricity and Machinery Hall to facilitate removal

work, very little electrical apparatus will be run, and Mr. Burnham proposes that the offices of the Department chiefs shall be lit by gas. The Council of Administration has asked to be dissolved not later than Nov. 20, but the electric lighting for the Administration Building is contracted for until Feb. 1, 1894. The Woman's Building lighting is under contract until December 1. The general arc lighting is due to cease on November 15. The electric launches and the electric fountains stop November 1 as per contract.

I have talked with many visitors in Electricity Building and find a general sense of relief and gladness that the long ordeal is so nearly over. But there is also a general sentiment of pleasure at the results, and many feel that if they had accomplished nothing in a commercial sense, they had had at least some share in the success and glory of the Fair as a whole. A large number of the exhibits are sold, as has been noted in these columns from time to time, and in a few short weeks they will be in service in widely scattered sections of this country or on the high seas bound for foreign ports.

STATISTICAL NOTES ON THE ELECTRIC LAUNCHES AT THE WORLD'S FAIR.

BY

R. W. Chamberlain

THE readers of this and other electrical journals have before been made acquainted with the general design, construction and electrical operation of the 54 electric launches operated by the Electric Launch and Navigation Company, on the lagoons of the World's Fair.

Believing that a concise statement of the actual work and operating cost of these launches will be of deep interest to the electrical fraternity, since the launches are operated under novel and severe conditions, the writer presents the following data which are computed from records carefully kept from the beginning of this unique business enterprise.

APRIL 18TH TO OCTOBER 1ST, 1893.

Mileage and Passenger Traffic.

Passenger trips of three miles each.	47,787
World's Fair special launch trips.	6,750
Special trips of regular launches.	1,220
Trial trips.	270
Experimental trips.	180
Total number of trips.	56,207
At three miles per trip, total miles.	168,621
Average miles per launch to Oct. 1st.	3,122
The total number of days the 54 electric launches have been in service on the lagoons of the World's Fair, is.	6,594
Therefore the general average of miles per launch, per day, is.	25.57
Minimum miles, per launch, per day	14
Maximum " " " "	37½
Maximum miles, one launch, one day.	54
Total number of passengers carried from May 1st, to October 1st.	801,000
Maximum passengers carried in one day by one launch	464
Maximum number of people carried by one launch for one round trip.	40

Operating Cost.

Average cost per launch, per day, for charging, at 3 cents per electric horse-power.	55½c.
Average cost per launch, per day, for care and repair of shafting, propellers, 54 motors, 162 packing boxes, 3,524 storage batteries, including labor for charging, 54 controllers—all the above being gone over every 24 hours.	43c.
Renewals of batteries per launch, per day.	41c.
Renewals and repair material for all else, per launch, per day.	9c.
Total cost per launch, per day.	$1.48½
Average cost per launch mile for labor and material, exclusive of office expenses.	5⅔c.

When it is understood that already the launches have run on an average four times the number of miles a launch owned by a private individual would ordinarily cover during a regular season, and that, as all who have been connected with this glorious Fair will vouch for, the operating expenses are decidedly heavier than under ordinary circumstances, it will be acknowledged that the cost per launch mile is exceedingly low. Judging from the experience of six months with the 54 launches the writer believes the expense can, and will be, in the near future, brought down to as low a figure as three cents per electric launch mile where at least 30 launches are operated under like conditions—less World's Fair extra expenses. Though the electric launches have carried over 801,000 passengers, not a single accident has occurred and it was exceedingly rare that a boat had to be towed in, except through injury to the propeller or shaft by the floating and sunken debris in the lagoons of the World's Fair.

At some future date the writer may give a list of the difficulties encountered in maintaining and operating electric launches on a practical scale and what methods are pursued to obviate them. As all know, every system, whether electric lighting, electric railway, or electric launches, all develop their own peculiar "bugs" which those in control seek to banish at the earliest opportunity.

To the designers of the launch, Gardner & Mosher, to the Consolidated Electric Storage Company, who supplied the storage batteries, to the General Electric Company who furnished the specially designed motor and particularly to the intelligent and industrious work upon the part of the employés under the skillful management of the officials of the company, is due the entire success of this, to very many, doubtful enterprise.

THE DIPLOMAS OF HONOR.

THE NATIONAL COMMISSION has adopted after some opposition, the scheme of awards presented by Mr. John Boyd Thatcher in which he suggests awarding honors to such governments, departments, States, municipalities, public institutions, and other organizations and officials as have materially contributed to the success of the World's Columbian Exhibition.

The award for such cases in addition to the exhibition medal will be a special diploma of honor, not otherwise different in design from the regular diploma except by the addition of a special designation. This diploma will be granted by the National Commission upon the recommendation of a special and honorary committee of judges nominated on the Committee of Awards.

This plan seems to meet with the almost universal disapproval of the exhibitors, as have most of the proceedings of the Committee of Awards.

AN ACCIDENT TO THE MOVABLE SIDEWALK.

ON the movable sidewalk on the Casino pier a few days ago a broken rail brought about an accident, which, however, did not result in serious injury to any one, though the walk was badly torn up. The accident was due to a flat rail three inches thick and four wide breaking on the stationary platform underneath the movable platform. The broken rail flew up and derailed the platform cars, throwing them together in almost inextricable confusion. Workmen repaired all damages the following day. Though half a dozen seats crashed into each other no one of the many occupants was injured beyond being slightly bruised.

OHIO UNIVERSITY "ELECTRICALS" AT THE WORLD'S FAIR.

PROF. B. F. THOMAS, of the Columbus, O., University and a leading member of the Jury of Awards, has had his "electricals" here this week going over the exhibits of special interest. They were received very cordially at the start in the headquarters of the General Electric Company, where a few words of general welcome were addressed to them by Lieut. E. J. Spencer, representing the Company, and Mr. T. C. Martin on behalf of the electrical press.

W. B. ROBERTS, general agent of the Muncie Electrical Works, has been in Chicago for a few days doing a big business and incidentally taking his farewell look at the World's Fair.

MISCELLANEOUS.

THE NEW PACKARD LAMP.

EVER since the recent decision in the incandescent lamp suits the manufacturers of the well-known Packard lamp, the New York and Ohio Company, of Warren, Ohio, have been busily engaged in the perfecting of a lamp which should be free from all previous patent claims and the result of their work is embodied in the new lamp illustrated in the accompanying engraving, Fig. 1, which differs from anything heretofore attempted in this country.

In the new lamp the neck is closed by cement and mica, and iron leading-in wires are used which are not sealed into glass. The factory of the company is now in full operation making the new style Packard lamp from 6 to 50 c. p.

A special porcelain socket and shade has to be used with the lamp. These are permanently attached to the fixture or suspending cord and do not have to be renewed with the lamp.

Packard "Moguls" are especially adapted for lighting stores, large halls, exhibitions, reception rooms, etc., and in short, wherever a good, steady and efficient light is required. At present they are made of 200, 300 and 500 c. p. and other sizes up to 1,000 c. p. are in course of preparation. We may add that the new lamp is protected by 20 patents.

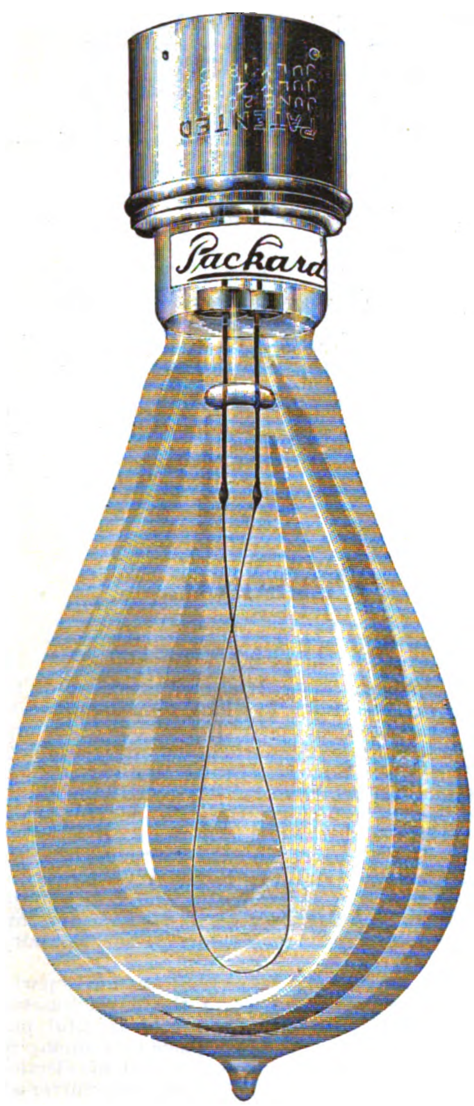


FIG. 1.—THE NEW PACKARD LAMP.

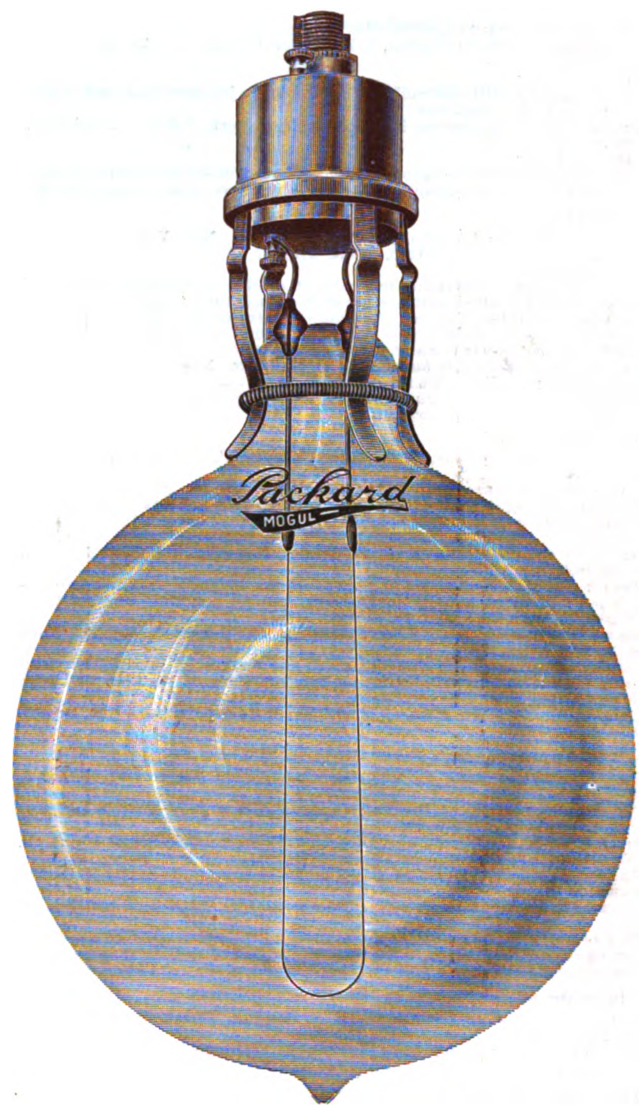


FIG. 2.—THE PACKARD "MOGUL" LAMP.

The Packard "Moguls," Fig. 2, are made in two classes, "A" (high efficiency) and "B" (longer duration); but they can be made specially for any efficiency. When they are run at the usual efficiency of the ordinary incandescent lamp, their life exceeds that of the latter, but for lighting large spaces it is found more economical to run them at the higher standard. Their cost is very small as compared to a group of small incandescent lamps, and the extra light gained will on the average pay for the cost of the renewal of the lamp after 150 hours of their life.

The carbons employed are of large diameter, of very low resistance, and are run at high incandescence in order to obtain high efficiency. The actual efficiency attained is 2¼ watts per candle power; as compared with arc lamps in opal globes a 300 c. p. Packard "Mogul" will consequently give nearly two-thirds the light for the same watt expenditure, without involving any expense for carbons, attendance, etc., and affording a steady light of a color pleasing to the eye. By the use of gas in the manufacture the candle power of the lamps is kept almost constant during the entire life of the lamp.

THE MADISON SQUARE BANK FAILURE.

MUCH interest has centred in the failure of the Madison Square Bank owing to recent developments which have led to the arrest of all the directors of the bank on various charges made by the receivers. Among those arrested was Mr. R. T. McDonald, president of the Fort Wayne Electric Co., who was immediately released on bail. According to the attorney for the receivers, Mr. McDonald subscribed for 1,000 shares of stock of the bank at $150 a share, for which he should have paid $150,000 in cash. He had his three notes of $50,000 each discounted by the bank to get money to pay this subscription, and when this loan was laid before the directors they were told that $200,000 of New Orleans electric bonds would be given as collateral. These notes were negotiable, and were made to the Fort Wayne Electric Light Co., of which Mr. McDonald was treasurer, and were endorsed by that company. When the bank failed it was found that a secret agreement was made at the time the notes were discounted, which in practical effect made the loans almost perpetual, because the bonds were not to be sold under 90, and 90 was not obtainable. The charge is that Mr. McDonald, taking advantage of his position as acting President of the bank, changed the entire character of this security, on which he had theretofore obtained a loan. Before that it could have been sold, but with that endorsement it became unsalable.

Inventors' Record.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 17, 1893.

Alarms and Signals:—

Automatic Sprinkler and Fire Indicator, J. S. Kiehl, Chicago, Ill., 506,700. Filed Oct. 19, 1892.

Electric Push Button, B. F. Rex, St. Louis, Mo., 506,729. Filed Feb. 16, 1893. The button itself consists of a miniature incandescent lamp, that it may be readily seen in the dark.

Electric Alarm System, G. F. Bulen, Bayonne, N. J., 506,841. Filed July 5, 1893.

An alarm system actuated by the simple grounding or breaking of a wire.

Visible Signal, F. S. Perrin, New York, 506,883. Filed May 15, 1893.

Has for its object to dispense with pivoted or hinged armatures and to secure a greater range of motion.

Conductors, Conduits and Insulators:—

Junction Box for Electric Cables, S. B. Fowler, Chicago, Ill., 506,683. Filed April 12, 1893.

Claim 1 follows:

The combination with the cables of a water tight junction box and water tight terminals inside said box.

Insulated Electric Conductor, L. F. Requa, New York, 506,830. Filed Dec. 24, 1892.

Claim 1 follows:

An insulated conductor or group of conductors enclosed in a sheath or tube of soft rubber held out of contact therewith by a fibrous insulating material.

Distribution:—

Electrical System for Distribution, C. O. Mailloux, New York and W. S. Barstow, Brooklyn, N. Y., 506,920. Filed April 27, 1893.

Claim 1 follows:

The combination of a series of bus-bars of graded potentials, a series of feeders or sets of feeders, switches for shifting said feeders at pleasure from one bus-bar to another, a source of variable electromotive force, and means for varying the same while connected to a feeder before transfer of said feeder from one bus-bar to another.

System for Electrical Distribution, C. O. Mailloux, New York and W. S. Barstow, Brooklyn, N. Y., 506,921. Filed June 23, 1893.

Relates to the manner of transferring a feeder from one bus-bar to another and means for effecting the transfer.

Dynamos and Motors:—

Dynamo Electric Machine, S. H. Short, Cleveland, Ohio, 506,740. Filed April 13, 1891.

Employs an armature composed of an annular core having notches in the sides of greater depth than width, and insulated wire bobbins of less thickness than depth wound in said notches and projecting beyond the periphery of the core.

Dynamo Electric Machine, F. A. Feldkamp, Newark, N. J., 506,774. Filed Nov. 15, 1892.

Has for its object such an arrangement of the magnets that the two adjacent poles shall be equally magnetised, and all magnetic lines of force shall pass through the armature.

Dynamo Electric Machine, F. A. Feldkamp, Newark, N. J., 506,775. Filed Nov. 19, 1892.

Employs an armature ring having a web and flanges in combination with spirally formed and insulated strips on opposite sides of the web and wire coils around the ring.

Regulator for Dynamo Electric Machines, J. Keller, Canton, Ohio, 506,881. Filed Oct. 10, 1891.

Lamps and Appurtenances:—

Clutch for Carbon Rods, C. McNellis, Chicago, Ill., 506,716. Filed June 6, 1893.

The gripping portions of the clutch are separate and removable and may be readily replaced when worn.

Manufacture of Electric Lamps, H. and F. G. A. Schulze-Berge, Brooklyn, N. Y., 506,738. Filed March 28, 1893.

Has for its object a system of detecting leaky lamp bulbs in the process of exhausting the air.

Electric Arc Lamp, A. Utzinger, Nuremberg, Ger., 506,890. Filed Dec. 15, 1892.

Employs a rotatable body of metal mechanically connected to one of the lamp electrodes and acted upon by a continuously shifting magnetic field whereby the electrodes are positively separated and the regulation effected.

Miscellaneous:—

Electric Synchronizer for Clocks, H. S. Prentiss, Elizabeth, N. J., 506,936. Filed Nov. 3, 1892.

Method of Manufacturing Copper Wire, E. Viarengo, Turin, Italy, 506,957. Filed April 5, 1892.

Railways and Appliances:—

Electric Locomotive, H. W. Libbey, Boston, Mass., 506,786. Filed April 21, 1892.

The invention consists in the special arrangement of locomotive and track for very high speeds.

Electric Railway Conduit, H. H. Franklin, Brooklyn, N. Y., 506,993. Filed July 13, 1893.

Claim 2 follows:

An electric conduit having an insulating lining, openings or pits communicating with it at its sides, a conductor, and supports for the latter only in the openings that hold it against the insulated conduit side.

Trolley Wire Hanger, B. B. Betts, St. Louis, Mo., 507,064. Filed Dec. 28, 1892.

Contains a fixed jaw, an adjustable movable jaw, a wedge adapted to hold the adjustable jaw clamped over the conductor and a wire fitted in the wedge to hold it in position.

Telegraphs:—

Printing Telegraph, L. P. Buck & F. D. Sweeten, Wilmington, Del., 506,973. Filed July 26, 1892.

Has for its object to connect a transmitting key-board with a receiving typewriter so that the receiving machine will be under the complete control of the transmitting operator.

Telephones and Apparatus:—

Apparatus for Suppressing Telephone Disturbing Currents, F. A. Pickernell, Newark, N. J., 506,884. Filed June 6, 1893.

Multiple Commutator Apparatus for Telephone Systems, L. A. Berthon, Paris, France, 506,658. Filed June 15, 1892.

Patent Notes.

PROCEEDINGS OF THE PATENT AND TRADE-MARK CONGRESS.

Doubtless many readers of The Electrical Engineer will find much of advantage and interest in the proceedings of the recent Patent Congress at Chicago. The following announcement will be useful to all such:

When published, the proceedings of the Patent and Trade-Mark Congress held at Chicago under the auspices of the World's Congress Auxiliary of the World's Columbian Exposition during the first week of October, 1893, will form a large and interesting volume, comprising about 40 papers or addresses from representative men in England, Germany, Sweden, Austro-Hungary, Holland, Switzerland, Canada, Mexico and the United States.

Among those who participated in the Congress were Hon. Henry W. Blodgett, for 23 years Judge of the U. S. Courts at Chicago; Hon. John W. Noble, ex-Secretary of the Interior; Hon. Richard Pope, Canadian Commissioner of Patents; Hon. John S. Seymour, U. S. Commissioner of Patents; Hon. Benton J. Hall, ex-Commissioner of Patents; Hon. Benjamin Butterworth, ex-Commissioner of Patents; Hon. William F. Draper, Member of Congress from Massachusetts and of Patent Committee of House of Representatives; Hon. James Buchanan, ex-Member of Congress from New Jersey and of Patent Committee of House of Representatives; Hon. Carroll D. Wright, U. S. Commissioner of Labor; Hon. W. Lloyd Wise, London, President Chartered Institute of Patent Agents; Judge Y. Sepulveda, Mexico, and many others well known in connection with industrial property, both in this country and abroad.

The papers or addresses are full of valuable suggestions and information which cannot fail to be of interest to scholars, statesmen, lawyers, inventors, manufacturers, trade-mark owners, and others interested in economic or industrial questions. When published, the book should be in the library of every one interested in industrial property; and it is especially desirable that it be placed in public libraries and in the hands of those interested in the work of shaping legislation in reference to such property in our own and other countries.

To provide for the expense of publication, which will necessarily be large, it has been deemed advisable to obtain subscriptions for at least 500 copies in advance of publication, at $5.00 per copy, bound in cloth, and $7.50, bound in leather. In this way, by liberal subscriptions, any one desiring to aid in making the work of the Congress effective—besides receiving a most valuable book for his own library—may encourage immediate publication of its proceedings.

Please have the kindness to fill out and sign the appended blank and return the same as soon as possible to the chairman of the committee on organization named below.

Ephraim Banning,
Chairman of Committee on Organization, 225 Dearborn street, Chicago.

R. J. Gatling,
President American Association of Inventors and Manufacturers.

Francis Forbes,
Secretary U. S. Trade-Mark Association.

Personal.

MR. SAMUEL LITTLE.

Mr. Samuel Little, the newly elected president of the West End Street Railway, of Boston, has long been identified with the street railway interests of that city. He was one of the organizers of the Highland street railway in 1872, and its treasurer until its consolidation with the Middlesex Street Railway Company, and since the uniting of all the street railways of Boston in the West End Company, he has been one of the directors of the latter corporation. Mr. Little is also president of the E. Howard Watch & Clock Company, the Boston Lead Manufacturing Company, the Bay State Gas Company and the Roxbury Gaslight Company, and a director of the Boston, Dorchester and South Boston Gaslight Companies. He is also a trustee of the Roxbury Institution for Savings, and one of the incorporators of the Roxbury Homœopathic Dispensary.

For more than 20 years Mr. Little took an active part in public life and was at one time member of the Massachusetts House of Representatives. His unbroken record of faithful public service and his successful business career place him among the truly representative men of the commonwealth, and his election to his latest presidential chair cannot fail to meet with universal approval.

MISS BERTHA LAMME, E. E.

Miss Bertha Lamme, of Springfield, Ohio, who recently received the degree of electrical engineer at the Ohio State University is said to be the first woman in the world to obtain this distinction. Miss Lamme has already accepted a position with the Westinghouse Company at Pittsburgh.

Mr. C. O. Harris, well known to the electrical fraternity everywhere, has accepted the position of electrician of the Memphis Light and Power Company, Memphis, Tenn., vice F. E. Boardman, resigned. Mr. Harris' extensive experience ably fits him for the position.

Dr. Johann Sahulka, who was delegate for the Austrian Government at the Chicago Electrical Congress, sailed for Europe on the *Dania*, on Oct. 26.

Mr. Harry Spangler Smith, of Philadelphia, was married on November 1st to Miss Ida Milla Fox, of Lebanon, Pa.

WESTINGHOUSE APPARATUS AND THE TESLA SYSTEM ADOPTED AT NIAGARA FALLS.

THE CATARACT CONSTRUCTION COMPANY, has finally, after a long and thorough investigation of all the means submitted for transmitting power at Niagara, awarded the contract to the Westinghouse Company who will employ the Tesla multiphase system. The introduction of multiphase currents was some time since determined upon, but after protracted examination the Cataract Company settled upon the two-phase plan, this being recognized as the most flexible and remunerative in commercial exploitation.

The contract primarily calls for three generators of 5,000 h. p. each with corresponding motors and accessories. The revolving fields of the generators will be constructed with inwardly projecting poles and will revolve in a horizontal plane, being mounted upon the vertical shafts of the turbines. The weight of the shafts, turbines and armatures is to be carried by the upward pressure of the water-columns producing the heads for the turbines. The E. M. F. generated will be 2,000 to 2,400 volts and will be increased by step-up transformers for long-distance transmission and lowered by reducing transformers for distribution. The motors will be the two-phase Tesla. The system adapts itself readily to the use of motor generators or rotary transformers so that it is possible to develop either single-phase alternating currents or continuous currents of any desired E. M. F. as may be required for the uses of individual customers. It is expected that a large amount of power will be employed for manufacturing purposes, arc and incandescent lighting, electrolytic work and power purposes generally. It is also understood that the company contemplates sending current at high electromotive forces to Buffalo and greater distances to be used for lighting and power purposes. The work upon the apparatus has already been begun and it will be installed at the earliest possible date.

This is a high tribute to the Westinghouse Company, and not less so to the merits of the multiphase system.

TRYING TO REPUDIATE WORLD'S FAIR LIGHTING CONTRACTS.

A COMMITTEE of the national organization of State Executive Commissioners, headed by Mr. Stevens, of Michigan, waited on the Council of Administration last week and also on Auditor Ackerman and presented the ultimatum of the states regarding pay for electric lighting furnished by the Exposition. It took the form of a resolution, setting forth the determination of the organization to resist the payment of electric lighting bills in excess of the rate of $1 per lamp per month for the actual time of service. The resolution was preceded by a preamble declaring that the lights furnished were inferior, had not been maintained according to the contract and that they were not worth the contract price of $1.33⅓ per lamp per month. The original contracts called for lights from May 1 to the close of the season, at the rate of $8 per lamp for the season. As the lights were not furnished until the middle of June the exposition officials offered a proportionate rebate for the first six weeks. This was not deemed a sufficient concession, and the state commissioners have decided to resist the payment of bills unless their ultimatum is accepted.

It seems rather late in the day to ask for a rebate when the Exposition is about to close, and the action of the commissioners reminds us strongly of the perennial claim of the gas consumer that the meter is out of order, after a month of festivities lasting far into the morning.

A CONDUIT EXPLOSION.

THE electric conduit manhole at the corner of Washington and LaSalle streets, Chicago, exploded the other day with a loud report, throwing the iron lid into the air. This was closely followed by an explosion at Washington and Fifth avenue, where a tongue of flame shot from the opening. Crossed electric wires had ignited the gas in the conduit, causing the explosion. Suitable precautions, such as are taken in New York and elsewhere, to keep the conduits and manholes free from gas, by air pressure or otherwise, would have avoided the accident.

SALE OF A WORLD'S FAIR EXHIBIT.

THE elaborate exhibit in the Electricity Building of the General Electric Company, Limited, of London, England, is to be sold instead of being sent back after the Fair is over. This exhibit, it will be remembered, formed the subject of an interesting article in our World's Fair Department, some months ago.

ELECTRICITY ON THE ERIE CANAL.

IT is announced from the office of the superintendent of public works that the Westinghouse Company will begin a trial on the Pittsford level near Rochester this week. Gov. Flower and some of the other state officers are to witness the test.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE CENTRAL ELECTRIC CATALOGUE.

THE CENTRAL ELECTRIC COMPANY have issued their 1893 catalogue. It is a volume of 525 pages bound in heavy board with beveled edges, and contains, carefully classified, the almost endless list of electrical supplies handled by the company. The fact that there is the least possible amount of descriptive text and that each page contains from one to a dozen entirely distinct pieces of apparatus will give some idea of the extent of the company's business and the scope of their catalogue.

A GREAT ELECTRICAL FEAT.

ONE of the greatest feats in electrical railroading ever witnessed in Reading, Pa., took place on the Reading and Southwestern, recently when the 60 h. p. Curtis motor car, No. 7, built by the Curtis Electric Manufacturing Company, of Jersey City, N. J., drew four trailers, with 485 passengers, from Mohnsville to 7th and Franklin streets. The officers of the company are proud of the feat, and expect to repeat it whenever occasion arises.

HARTMANN & BRAUN.

IN addition to the elaborate bound catalogue of Messrs. Hartmann & Braun, of Bockenheim, Frankfort a. M., the firm have recently issued a less pretentious but equally interesting supplement for 1893 containing descriptions of many new pieces of apparatus, the more important of which have been described in THE ELECTRICAL ENGINEER in connection with the firm's excellent exhibit in the Electricity Building at the World's Fair.

WESTERN NOTES.

THE AMERICAN BATTERY COMPANY, of Chicago, have reason to feel proud over their successes at the World's Fair. They were the only American makers of storage batteries to receive an award. The following are the terms used by the judges in making their award :

"We affirm that the 'American' battery has been examined and tested by us, and found worthy of an award for its excellency of design and construction, and for its efficiency and indications of durability."

(*Signed*) WILBUR M. STINE.
W. LOBACH.

MR. HARRY G. OSBURN well known to the trade in the West, having held several responsible positions with some of the older companies in the electrical business, has opened an office as consulting, constructing and supervising engineer. Mr. Osburn's experience amply fits him for this business. He has an enviable reputation and acquaintance which should ensure him a splendid reception by the electrical trade generally.

THE CENTRAL ELECTRIC CO., of 116 and 118 Franklin street, Chicago, have issued an Okonite price list, No. 6, a tastefully arranged little book with stiff covers containing 55 pages. All sorts of Okonite products from lamp cord to 8,000 volt cables are listed, as well as tubing and tape of the well known Okonite compound.

MR. CHARLES WIRT, until recently electrical engineer of the Ansonia Electric Company has opened an office at 56 Fifth avenue, Chicago. He will make a specialty of expert work in connection with incandescent lighting, and the designing of special apparatus.

THE NEW HOME SEWING MACHINE CO. at Orange, Mass., have placed a contract with the Berlin Iron Bridge Co., of East Berlin, Conn., for a new foundry and tumbling room. The building will be entirely of iron, 45 feet in width and 120 feet in length.

PHILADELPHIA NOTES.

THE EUREKA TEMPERED COPPER COMPANY, of North East, Pa., have received the following flattering testimonial:

GENTLEMEN :—
Please, send us by mail four sets of Western Leaf Brushes of Tempered Copper.
The last four sets you sent us have run just 18 months and we are more than pleased with them.

Very truly yours,
PALMYRA LIGHT AND WATER COMPANY,
A. M. HOWARD, Supt.

THE LA ROCHE ELECTRIC WORKS closed last week contracts for six large plants. The works are now running night and day and the company report business as excellent even beyond their fondest expectations.

STIRN'S UNIVERSAL ELECTRIC PULL SOCKET.

THE accompanying illustrations show a pull socket and switch manufactured by the Universal Electric Pull Socket and Switch Company, of 27 Beaver street, this city. The socket is adapted for use with the Edison, Thomson-Houston and Sawyer-Man lamps, and makes and breaks the circuit by merely pulling a cord or chain, whether the lamp be arranged to project upward, downward or laterally.

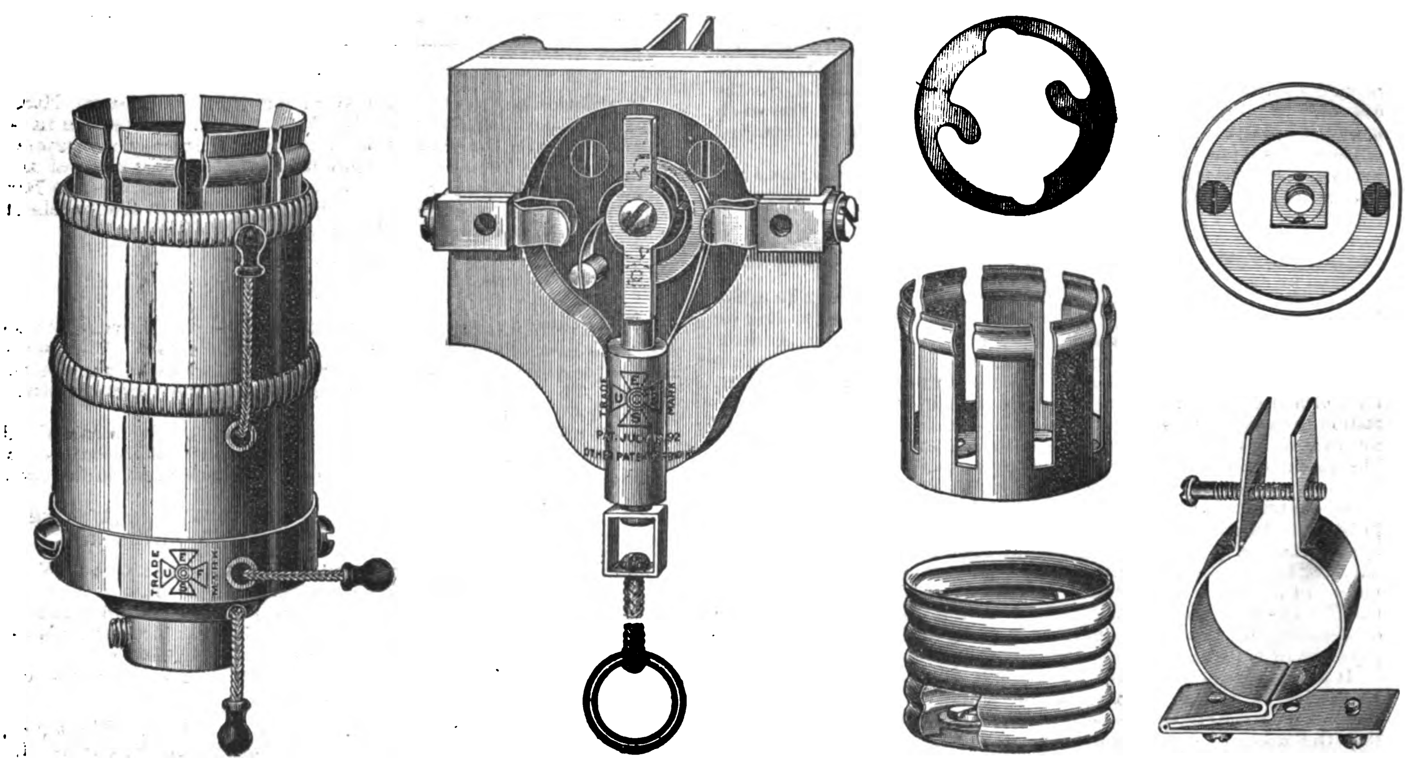
For the Thomson-Houston lamp no adjustment of the socket is required, and all that is necessary is to screw the central split-screw of the socket into the screw-hole in the foot of the Thomson-Houston lamp, whereby the lamp is held securely and the proper connection made.

For the Edison lamp the screw-neck must be inserted into the socket. The two opposite screws in the bottom of the top cavity of the socket are slightly loosened and then the screw-neck is inserted in such a manner that the heads of the screws can pass through the diametrically-opposite notches in the bottom flange of the screw-neck, and the screw-neck is then given a quarter-turn on its longitudinal axis, so as to cause the two hook-prongs to pass under the heads of the screws. The screws are then drawn up tight, whereby the screw-neck is held securely in the bottom part of the socket. All that is necessary is to screw the Edison lamp into it, when the lamp is held securely and the proper connection made.

For the Sawyer-Man lamp the longitudinally-cut spring neck is inserted and fastened in the same manner as the screw-neck for the Edison lamp. The lamp is held by the several prongs of the split spring neck, the pin on the foot of the lamp passing into the split hollow screw in the socket.

When the lamp projects upward the cord or chain connected with the switch-lever in the socket is passed through the aperture in the base of the socket. In case the lamp is to be held horizontally, the cord or chain is passed over a grooved friction-pulley in the lower part of the socket and through the side aperture of the socket near the base. In case it is to project downward, the cord is also passed over the grooved friction-pulley and through the side aperture in the socket. It is only necessary to pull down to make or break the circuit and the cord after having been pulled returns automatically to its original position.

The pull switch is simple and durable, with excellent contacts and is easy put in circuit. The circuit in the switch is broken and made instantaneously by simply pulling the chain or cord. It has brushing contacts which wear bright by use and is easily adjusted to any electrolier, by its adjustable extension clamp. It is adapted to from ⅛ to 1⅛ inch piping, and is out of sight, being covered by the canopy of the electrolier.



DETAILS OF THE STIRN UNIVERSAL ELECTRIC PULL SOCKET AND SWITCh

THE USE OF DE RYCKE STEAM SEPARATORS IN HIGH SPEED ENGINES.

THE great speed and perfect working of the two recently completed U. S. gunboats, *Machias* and *Castine*, has awakened considerable interest in their mechanical equipment. These vessels were built by the Bath Iron Works, of Bath, Maine, the required speed being 18 knots per hour. The premium by contract was at the rate of $5,000 per quarter knot exceeding this speed, and the *Machias* won for its builders a premium of $45,000 and the *Castine* $50,000. This excess of speed could only have been made possible by exercising the greatest care in the selection of machinery necessary for their perfect equipment; employing only that of the most improved design and manufacture.

It is interesting in this connection to note the following communication addressed to Mr. Joseph De Rycke, of 145 Broadway, New York City, the manufacturer of the De Rycke steam separator.

DEAR SIR :—We have placed your six-inch separators in the main steam pipes of the *Machias* and *Castine*, twin screw triple expansion gunboats just completed by us for the U. S. Navy. Not only do they perform their duty perfectly in ordinary running, but by their evident ability to take care of "priming" tendencies they give to the engineers and crew the confidence which is so necessary to the successful working of this "high tension" machinery. The perfect working and unprecedented excess of speed of both these gunboats on their recent official four hour trials, where the *Machias* exceeded the contract speed by 2.46 knots and the *Castine* by 3.032 knots, is in evidence.

Yours very truly,

BATH IRON WORKS.

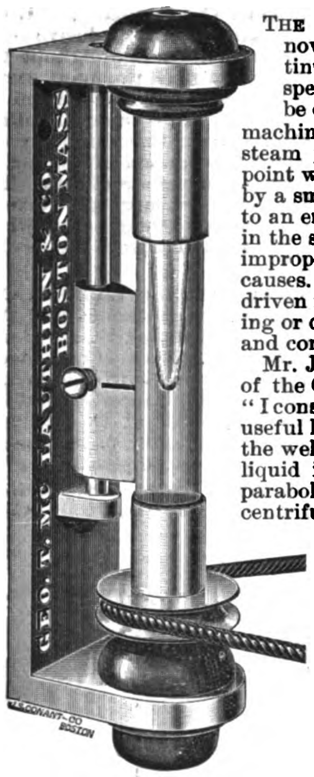
Oct. 15, 1893.

Four 6-inch and two 2½-inch De Rycke separators were used in the equipment of the two vessels. Mr. De Rycke also furnished two 9-inch separators to the Bath Iron Works for the U. S. Ram *Katahdin*; also a 8-inch separator which is now in use at the end of fitting-out wharf of the same concern on a new 100-ton hoist. The following extract from a recent letter to Mr. De Rycke, regarding the working of this separator is of some interest. We quote:

We have just placed the 8-inch separator you sent us and given it a short trial and it works perfectly. We can start the engines at full speed immediately without danger from water, although at the end of about 300 feet of pipe 8 inches diam. In first starting the reservoir will fill about three times and after that about once every half hour or by allowing the drain to stand a very little way open (not enough to allow all the water out or allow steam to escape) it only needs attention after long intervals.

With such evidence of its merit as that quoted above and in the light of the excellent results attained in connection with its use on the *Machias* and *Castine*, the popularity of De Rycke separator seems to be deserved.

THE McLAUTHLIN SPEED INDICATOR.



McLauthlin Speed Indicator.

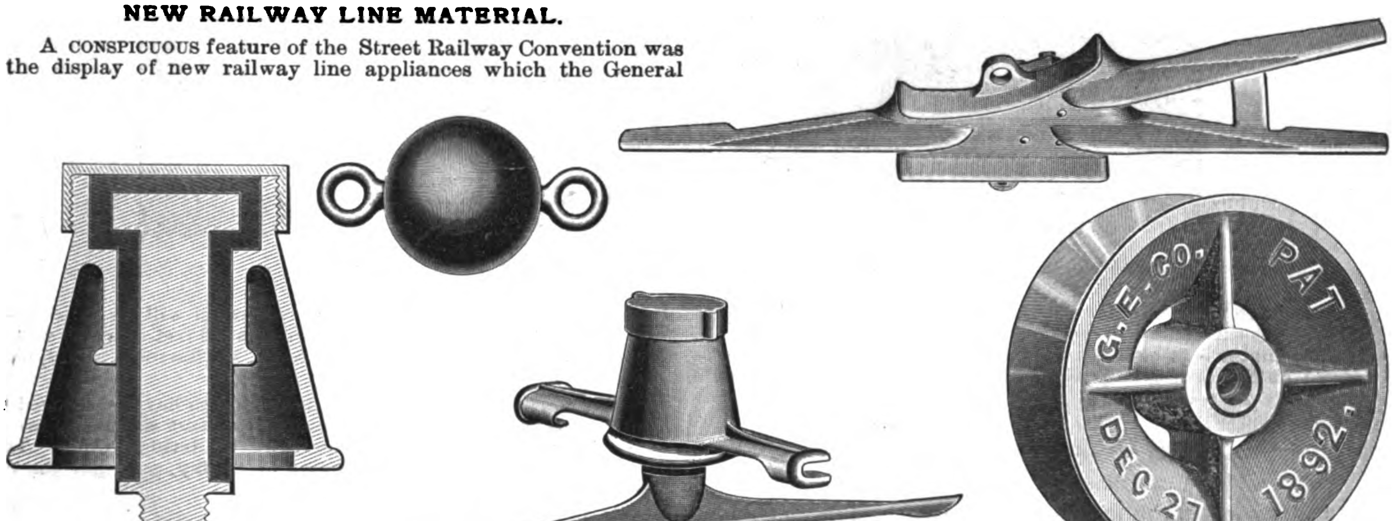
THE accompanying illustration shows a novel instrument, which indicates continuously the speed and variations of speed of any machine to which it may be connected. It may be placed at the machine, in the office, in the cabin of the steam yacht, or at any other convenient point where motion can be conveyed to it by a small cord or by friction. Connected to an engine, it plainly shows irregularities in the stroke due to a light balance wheel, improper setting of the valve or other causes. Connected to a dynamo or other driven machine it will show errors in belting or operating and leads to the discovery and correction of irregularities and defects.

Mr. J. G. Henderson, Engineer-in-Chief of the General Electric Co., N. Y., says: "I consider this gauge a most accurate and useful little instrument. It is based upon the well known law that the surface of a liquid in rotation assumes the form of a parabola, being acted upon horizontally by centrifugal force and vertically by gravity. One of these instruments suitably connected to an engine, dynamo, motor, or other machine will show whether the speed is up to the mark at a glance, the index being set to correspond to the normal number of revolutions per minute. The gauge gives the best results when driven at a high speed, when a small variation will make quite a difference in the indication. Most tachometers have springs, levers and other mechanism—all of which are liable to get out of order, but this one has only the very simple parts necessary to bring it into action, and is based on two fundamental physical laws which cannot possibly change."

This gauge is patented and sold by Geo. T. McLauthlin & Co., 120 Fulton street, Boston, Mass., and is especially adapted for connection to engines, dynamos, looms and all other machines requiring a regular speed, as well as for trolley cars as a speed indicator.

NEW RAILWAY LINE MATERIAL.

A CONSPICUOUS feature of the Street Railway Convention was the display of new railway line appliances which the General Electric Company has just brought out. They differ in some respects from those hitherto associated with the name of the company. The design of each piece shows especial care and that of some of the appliances has been modified slightly.



NEW GENERAL ELECTRIC RAILWAY LINE MATERIAL.

The trolley hanger, known as form "E" is already in use on several roads. The metallic parts are of bronze. The insulation used is known as the "L" compound, and is hard, homogeneous and solid. The bolt is also of bronze, and is covered with the "L" compound. All the suspension bodies are strong, durable and so constructed as to be very readily placed in position on the line. It will be seen that their construction is such as best to adapt them to the heavy strain and hard usage incidental to street railway practice. The bell portion is wide and deep and affords thorough protection from both moisture and accident. In putting up this device the ear may be soldered to the wire, the bolt thrust through the suspension body and screwed into the ear, and then the cap screwed over the body and tightly locked, making a joint that is waterproof.

In the trolley frogs the important feature is the disposition of the runways. That for the straight track is larger, and is placed somewhat in advance of that for the turnout. The wheel is thus caught more quickly, and the chance of its running off is lessened. The runways are straight, and are so made as to be on the same level as the trolley wire. They are furnished with projecting lips that can be bent over the trolley wire, and the appliance can thus be used without soldering until their definite position has been determined.

In addition there is a new patent spoked trolley wheel in which the spokes or ribs serve to hold the flanges in position after the wheel is worn out, and the car may be run back to the car house without help.

BRUCE & BOARDMAN.

ONE of the latest acquisitions to the list of contracting and supply firms is that of Bruce & Boardman, of Memphis, Tenn. The firm is composed of B. M. Bruce, a wealthy young business man, and F. E. Boardman who for the past six years has held the position of superintendent and electrician of the Memphis Light and Power Company, which is a sufficient guarantee of their ability to handle anything in their line. They have fitted up elegant quarters at No. 71 Union street, opposite the Lyceum Theatre, and invite their brethren to call. Mr. Boardman is now in the North purchasing the stock. We predict for them a prosperous career.

THE BRADLEY GAS GENERATOR.

MR. H. A. BRADLEY, the inventor and manufacturer of the Bradley gas generator for producing fuel and illuminating gas by the decomposition of steam and refuse oil or coal dust has received the following flattering testimonial:

HENRY A. BRADLEY, Esq.

Dear Sir:—We have now in use in our furnaces and under our boilers twelve of your direct gas generators, three of which we have used continually day and night for the past three months.

We desire to say that after a full and exhaustive trial we find them far superior to anything we ever used and entirely satisfactory. On account of simplicity, economy, uniformity of heat and ability to maintain any desired degree of temperature by means of your gas producer, we could not be induced to return to the use of coal.

We beg to state more in detail the advantages of your patent device in our business as follows:

1. Double the output of manufactured material. 2. A clear and better quality of glass produced. 3. A saving of 50 per cent. in cost of labor, and 50 per cent. in cost of fuel.

We have no air compressors, pumps or blowers, noise, coal, ashes or dirt.

We must say that we were astonished at the results produced by your gas machine and will cheerfully recommend it to manufacturers, who require a high and uniform heat.

We are, yours respectfully,

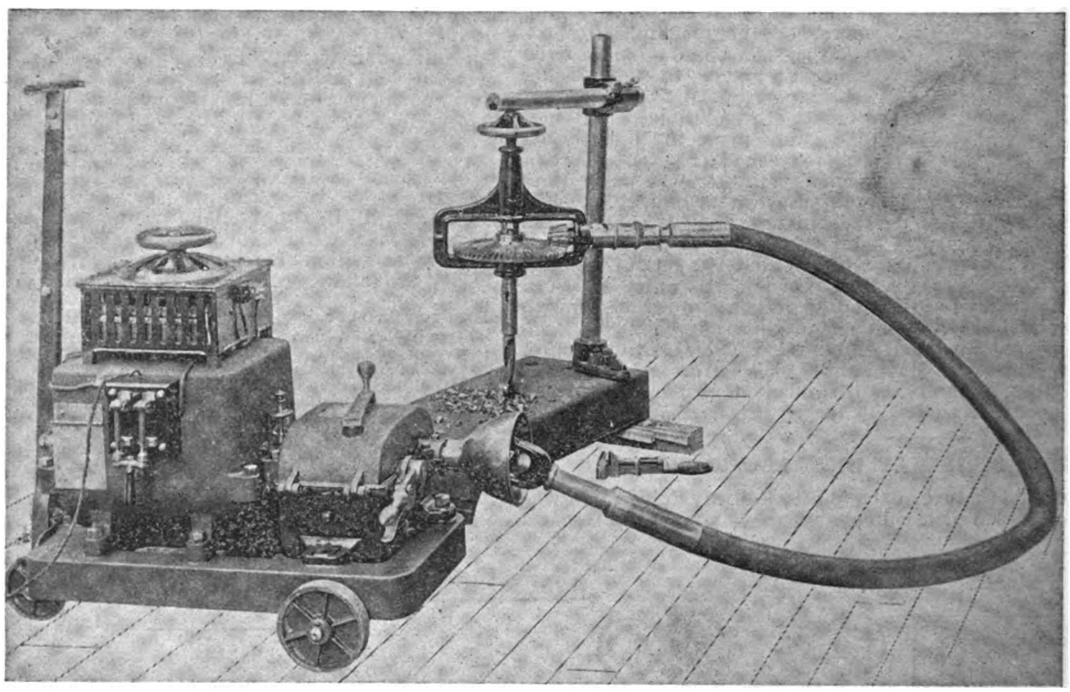
M. A. SMITH.

AMERICAN GLASS BENDING AND BEVELING WORKS,
NEWARK, N. J., October 12, 1893.

GENERAL ELECTRIC PORTABLE DRILL WITH FLEXIBLE SHAFT.

In that part of the General Electric Co.'s World's Fair exhibit in Electricity Building devoted to motors and their different applications, there is shown a portable drill with a flexible shaft. This has been brought into existence to avoid the inconvenience experienced whenever it becomes necessary to drill a piece of metal too large and cumbersome for manipulation under an ordinary upright drill, and to do work, usually done with a hand-ratchet drill, more rapidly.

The machine consists of a motor and a gear box mounted together on a truck, a flexible shaft, a drill press and drill rest. In addition, the motor carries on its side a double-pole switch, and on top a starting rheostat. The motor is shunt wound and has two poles, with one spool on the top of the field. The armature is of the Gramme ring type, and its shaft carries a pinion serving to drive the flexible shaft through change and reduction gears, enclosed in a gear box, and running in oil or grease. A universal joint coupling connects the change gear shaft to the flexible shaft, which carries on the drill press end a clutch coupling which may be used for starting and stopping the drill. A second reduction in speed is obtained by the bevel gears driving the drill spindle. The drill press is held by a stand and arm which may be clamped in any position. Increase or decrease of speed is readily obtained by a movement of the side handle; and by another movement the intermediate gears are thrown in or out of mesh, when the upper lever slides the change gears into position.



General Electric Portable Drill with Flexible Shaft.

This motor is rated at 4 h. p., and runs at 1,000 revolutions reduced at the drill spindle, according to the three positions of the change gears to 167, 83 and 12 revolutions. The machine is built for use with drills up to two inches in diameter.

NEW ENGLAND NOTES.

The Boston Electric Wire Co., of Allston, Mass., are now in the market with a very high grade of magnet wire, manufactured on machines of entirely new design. These machines will turn out wire, it is said, one third faster than any other machine in use, and make a wire of great excellence and uniformity of covering both as regards quality and diameter. They have been experimenting on these machines for about a year, and are now prepared to manufacture all kinds of magnet wire in sizes from No. 40 to No. 16, single or double covered in any quantity. The covering on wire of their manufacture is close, even and regular. The company have a large and thoroughly equipped factory in Allston, and are already busy on large and important orders. Larger sizes of magnet wire will be furnished later. They are at present also engaged in the manufacture of annunciator wire of the usual sizes and insulation. Mr. C. A. Clark, who has for the past fifteen years been identified with the B. S. Hale Company, of Malden, Mass., has associated himself with this company and will hereafter act as their travelling sales agent, his large experience in this line giving him unsurpassed qualifications for this position.

The Combination Car Company, of Boston, have just completed an arrangement with the Laconia Car Company, of Laconia, N. H., by which the latter company has the exclusive right to manufacture and sell the combination car throughout the United States. We have already fully described the many excellent features of this car, which can quickly be changed from an open summer car into a closed winter car. Mr. Gilman B. Bolton, treasurer and manager of the Combination Car Company has worked long and tirelessly to achieve the success of his car, to bring it to the front and make it a leader among street cars. The Laconia Car Company as is well known have a large and successful plant in Laconia, ample capital and an excellent reputation, and with their push and influence, are sure to achieve success for the combination car.

The North Attleboro Municipal Electric Light Plant, for the town of North Attleboro, Mass., has contracted with Mr. A. B. Griggs, New England agent of the Clonbrock Steam Boiler Works, of Brooklyn, N. Y., for one 250 h. p. Morrin climax steam generator. The station is now being built, and will contain one 500 h. p. tandem engine and one 100 h. p. high speed engine. It is being constructed under the supervision of Mr. C. O. Mailloux, of New York. The plant will provide arc lights for the streets, and arc and incandescent lighting for commercial purposes.

The Philadelphia Traction Company have placed the order for their new power house with The Berlin Iron Bridge Company, of East Berlin, Conn. The side walls will be of brick and the roof will be of iron. The building is 190 feet in width and 168 feet in length, divided into boiler room, engine room and dynamo room.

The Brown Electric Company of Boston has just secured the entire overhead equipment amounting to about sixteen miles for the Meriden Street Railway Company, of Meriden, Conn. They report business brisk and improving every day, and that the outlook is beginning to be much brighter.

The Consolidated Car-Heating Company, Albany, N. Y., has received World's Fair awards upon the following devices: 1. The Sewall steam coupler; 2. Multiple circuit hot water system; 3. Improved commingler hot water system; 4. Direct steam system.

The Commercial Cable Company furnished the news of *Vigilant's* victory to the Glasgow *Evening Times* three minutes after the winning yacht had crossed the line. The dispatch took 30 seconds to travel from New York to Glasgow.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVI. NOVEMBER 8, 1893. No. 288.

THE TESLA ELECTRICAL OSCILLATOR.

OUR readers will recall our short résumé of Mr. Tesla's lecture before the International Electrical Congress in Chicago,[1] which gave in brief outline the results accomplished in the search for an apparatus which would enable the electrical engineer to obtain currents or electrical oscillations economically without engines with rotating parts. The subject was an entirely novel one and came rather unexpectedly, and perhaps the majority of technical men have not even yet fully realized the full scope and far reaching effects of Mr. Tesla's novel work. We believe, therefore, that many will be interested in additional details relating to this work, and it is with this object in view that we give here a description of one form of Mr. Tesla's apparatus which he used in the lecture above referred to. Mr. Tesla, at that time, in compliance with a generally expressed desire left one of his oscillators in his personal exhibit at Chicago, until the end of the Exposition, and also, for fully a week, allowed all of his lecture apparatus to remain in the annex to the Agricultural Building where the lecture was held, and where it was inspected by numerous interested visitors.

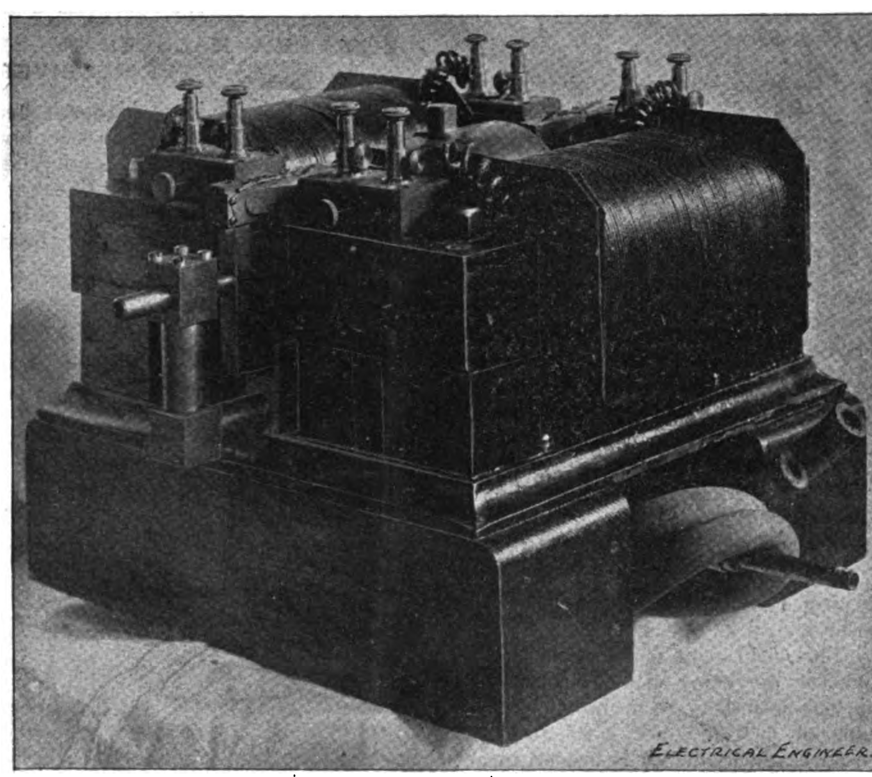


FIG. 1.—THE TESLA ELECTRICAL OSCILLATOR.

As we stated in our brief account, in these oscillators a freely movable piston, which is not connected to any rotating parts possessing inertia, as in ordinary engines, but which oscillates directly a coil or magnet and so generates electric current. Mr. Tesla pointed out in his lecture the great difficulty he had encountered in obtaining mechanical oscillation; he explained how he was guided first, in his earlier attempts, to imitate the process in a Leyden jar, in which electrical oscillations follow from an inadequate rate of supply, as compared with the rate of consumption. He exhibited a number of drawings showing apparatus in which he first employed compressed air passing through an opening, the section of which was properly calculated so that the rate at which the air was supplied was not sufficient to keep up a steady pressure; the latter would therefore suffer a sudden diminution upon a plunger being pushed to certain distance. By applying the simple laws of mechanical oscillation, determining, namely, the rigidity of the air spring and the weight of the movable parts, he was able to maintain oscillations ranging from small numbers to the most rapid mechanical vibration. He then devoted his energies to the perfection of the many varieties of apparatus of this kind with a special object of using steam as the working fluid, and getting the greatest mechanical and thermal efficiency out of the apparatus. Mr. Tesla was very sanguine in his expectations and from his remarks on that occasion we gathered that a vast field is opened up which will yield important practical results.

Our engraving Fig. 1 shows, in perspective, one of the forms of apparatus used by Mr. Tesla in his earlier investigations, and its interior construction is made plain by a sectional view shown in Fig. 2. It will be noted that the a piston P is fitted into the hollow of a cylinder C which is provided with channel ports O, O, and I, extending all around the inside surface. In this particular apparatus there are two channels O O for the outlet of the working fluid and one, I, for the inlet. The piston P is provided with two slots S S′ at a carefully determined distance, one from the other. The tubes T T which are screwed into the holes drilled into the piston establish communication between the slots S S′ and chambers on each side of the piston, each of these chambers connecting with the slot which is remote from it. The piston P is screwed tightly on a shaft A which passes through fitting boxes at the end of the cylinder C. The boxes project to a carefully determined distance into the hollow of the cylinder C, thus determining the length of the stroke.

Surrounding the whole is a jacket J. This jacket acts chiefly to diminish the sound produced by the oscillator and as a jacket when the oscillator is driven by steam, in which case a somewhat different arrangement of the mag-

[1] See THE ELECTRICAL ENGINEER, Aug. 30, 1893.

nets is employed. The apparatus here illustrated was intended for demonstration purposes, air being used as most convenient for this purpose.

A magnetic frame M M is fastened so as to closely surround the oscillator and is provided with energizing coils which establish two strong magnetic fields on opposite sides. The magnetic frame is made up of thin sheet iron. In the intensely concentrated field thus produced, there are

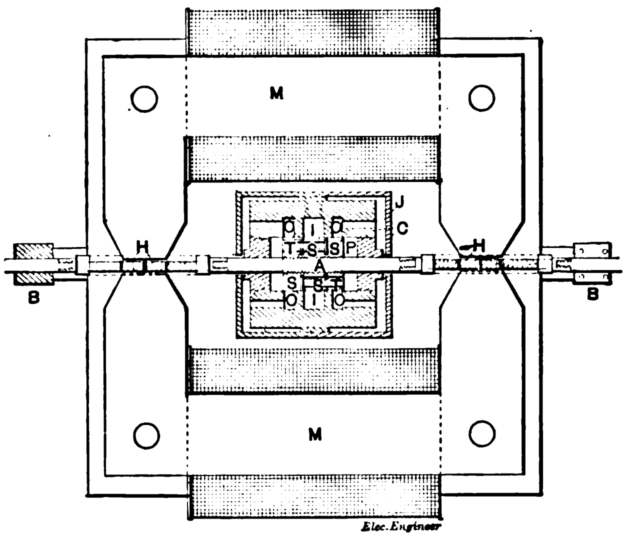


FIG. 2.—THE TESLA OSCILLATOR.—SECTIONAL VIEW.

arranged two pairs of coils H H supported in metallic frames which are screwed on the shaft A of the piston and have additional bearings in the boxes B B on each side. The whole is mounted on a metallic base resting on two wooden blocks.

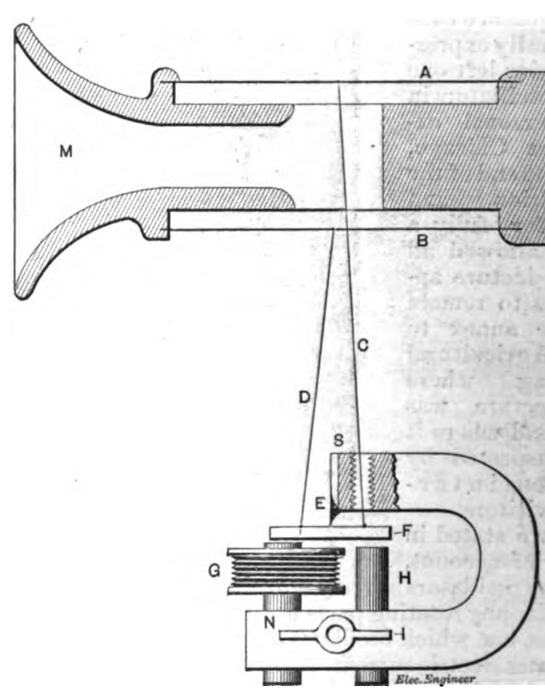
The operation of the device is as follows : The working fluid being admitted through an inlet pipe to the slot I and the piston being supposed to be in the position indicated, it is sufficient, though not necessary, to give a gentle tap on one of the shaft ends protruding from the boxes B. Assuming that the motion imparted be such as to move the piston to the left (when looking at the diagram), then the air rushes through the slot S′ and tube T into the chamber to the left. The pressure now drives the piston towards the right and, owing to its inertia, it overshoots the position of equilibrium and allows the air to rush through the slot S and tube T into the chamber to the right, while the communication to the left hand chamber is cut off, the air of the latter chamber escaping through the outlet O on the left. On the return stroke a similar operation takes place on the right hand side. This oscillation is maintained continuously and the apparatus performs vibrations from a scarcely perceptible quiver amounting to no more than $\frac{1}{64}$ of an inch, to vibrations of a little over $\frac{5}{8}$ of an inch, according to the air pressure and load. It is indeed interesting to see how an incandescent lamp is kept burning with the apparatus showing a scarcely perceptible quiver.

To perfect the mechanical part of the apparatus so that oscillations are maintained economically was one thing, and Mr. Tesla hinted in his lecture at the great difficulties he had first encountered to accomplish this. But to produce oscillations which would be of constant period was another task of no mean proportions. As we pointed out, in the article before referred to, Mr. Tesla obtains the constancy of period in three distinct ways. Thus, he provides properly calculated chambers, as in the case illustrated, in the oscillator itself ; or he associates with the oscillator an air spring of constant resilience. But the most interesting of all, perhaps, is the maintenance of the constancy of oscillation by the reaction of the electromagnetic part of the combination. Mr. Tesla winds his coils, by preference, for high tension and associates with it a condenser, making the natural period of the combination fairly approximating to the average period at which the piston would oscillate without any particular provision being made for the constancy of period under varying pressure and load. As the piston with the coils is perfectly free to move, it is extremely susceptible to the influence of the natural vibration set up in the circuits of the coils H H. The mechanical efficiency of the apparatus is very high owing to the fact that friction is reduced to a minimum and the weights which are moved are small ; the output of the oscillator is therefor a very large one.

Theroretically considered, when the various advantages which Mr. Tesla holds out are examined, it is surprising, considering the simplicity of the arrangement, that nothing was done in this direction before. No doubt many inventors, at one time or other, have entertained the idea of generating currents by attaching a coil or a magnetic core to the piston of a steam engine, or generating currents by the vibrations of a tuning fork, or similar devices, but the disadvantages of such arrangements from an engineering standpoint must be obvious. Mr. Tesla, however, in the introductory remarks of his lecture, pointed out how by a series of conclusions he was driven to enter this line of work because of the necessity of producing currents of constant period and his endeavors to maintain electrical oscillation in the most simple and economical manner. A further development of this work will no doubt be watched with great interest.

FIELD'S NEW MAGNETO TELEPHONE TRANSMITTER-RECEIVER.

MANY attempts have hitherto been made to obtain increased range of efficiency in telephone work by employing a multiplicity of diaphragms coupled to a multiplicity of current generating devices. These attempts have generally resulted in failure ; increased volume of sound has in some cases been secured, but at the expense of clearness of articulation.



FIELD'S MAGNETO TELEPHONE TRANSMITTER.

The reason for this may be looked for in the fact that no account has been taken of the necessity for securing unison of movement of all the diaphragms. When exposed to the influence of vibrations of a frequency of many thousand per second, independent diaphragms cannot possibly be made to synchronize and in the event of one approaching

the poles of the magnets while another is receding a complete neutralization of all current-generating effect is produced. It was the recognition of these principles that led that versatile inventor, Mr. Stephen D. Field, to the construction of a magneto telephone transmitter which bids fair to assume a prominent position in the telephone field, owing to its remarkable properties.

In the apparatus, which is illustrated in the accompanying diagram, the diaphragms are equally distant from a common mouthpiece; consequently they receive simultaneous impulses; they are, moreover, mechanically connected and under exactly the same tension and consequently they cannot get out of unison. Lastly, their combined effort is delivered on a single current generator so that no electrical "racing" is possible.

In the illustration, A, B, are two diaphragms so mounted that air waves projected through the mouth piece M will simultaneously impinge upon their inner surface, giving them equal and opposite movement. These diaphragms are coupled by means of the short steel wires C, D, to the extremities of a soft iron armature F which is centrally mounted on the S pole of a permanent magnet by bearing on a knife edge E. G is the generating coil surrounding a soft iron prolongation of the N-pole of the magnet; an idle pole H is provided to temper the directive attraction of the inducing core.

It will be seen that opposite movements of the diaphragms are brought into harmonious relation by reason of their being coupled to opposite ends of the centrally hung armature; also that, although the diaphragms are at all times under a state of mechanical strain, it is balanced strain and therefore susceptible to the slightest directive effort, the feeblest vibrations causing a very considerable armature movement.

This apparatus has been practically operated in exchange work and also over a circuit between New York and Philadelphia. Excellent results have been obtained, the volume of sound being ample and clearness of articulation unsurpassed.

When used as a receiver for the ordinary carbon transmitter, the volume of sound is so great that it is not necessary to hold the apparatus close to the ear and the delivered articulations can be heard by several persons simultaneously.

WORLD'S FAIR DEPARTMENT.

WAITE & BARTLETT ELECTRO-MEDICAL APPARATUS AT THE FAIR.

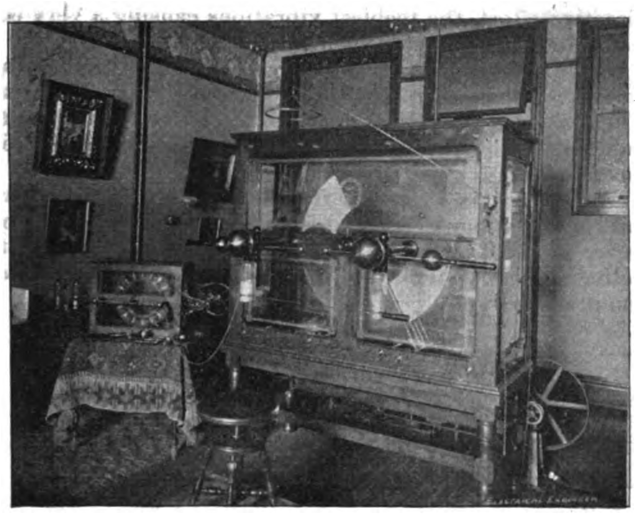
The science of electro-therapeutics has been advancing with giant strides these later years of the century which has witnessed its evolution from empiricism to exactitude, and to-day the assertion may reasonably be made that much of the apparatus employed in the healing arts is as accurate in conception and as finished in design as any of the more formidable appliances used in the generation and delivery of heavy current. The apparatus shown in Electricity Building by the Waite & Bartlett Manufacturing Company of New York, under the auspices of Dr. Waite and his son, comes within the category of sound engineering, for it aims at correct proportioning, at ease of control, at precision of application and at certainty of effect. This is no more than can be said of an arc lamp or a constant potential motor, while it is more than can yet be said of some of the high potential static and dynamic apparatus that is being urged upon a timid world as the best for light and power. Dr. Waite has the double advantage of being at once trained in medicine and in electricity, from which fact the best results may be inferred.

The Ranney and Engleman Electro-Medical Cabinets.

The exhibit in the gallery of the Waite & Bartlett apparatus comprises, of course, their familiar and standard detail apparatus, in cauteries, electrodes, coils, batteries, etc., as well as the family sets, the use of which under proper professional advice is often attended with considerable benefit, and the introduction of which gains ground with the growing favor of electricity among physicians of all schools. Note may also be made, in passing, of their standard milliamperemeters, dead beat, and their coulombmeters, based on the decomposition of water. But the most striking pieces in a very interesting and instructive collection are the "Ranney" cabinet, the Engleman cabinet and the large static machine, of the same size as that with which Dr. W. J. Morton recently reproduced some of the Tesla effects before the American Institute of Electrical Engineers and the New York Electrical Society, at Columbia College. The two cabinets, named respectively after two electro-therapeutists well known in New York practice and clinics, are seen in the front of the exhibit. The larger, on the left, is the Ranney, and has galvanic and faradic currents, to be used separately or combined. It is said to be the only cabinet by means of which the resistance of a patient, or for that matter of any human being, can be closely and accurately measured. Its adjustments are remarkably fine in their graduation and subdivision, and some tests with this would be well worth the making. The smaller Engleman cabinet, on the right, has the Engleman interrupter, by means of which it is possible to get all the way from one interruption in two minutes to 100,000 in one minute. In other words it can be set at any rate of interruption desired. It has also a spring vibrator, run by a separate cell, and not in circuit with the primary coil. Hence the current in the primary can be increased or decreased without interfering with the vibrator. Both of

these instruments are beautifully constructed, and what one may call the switchboard parts are so true and positive in their action that they must make many an ordinary builder of switchboards blush or feel weary.

The static machine already spoken of above, stands 6 feet long, 7 feet high and 2½ feet wide. It has six plate glass discs 40 inches in plane diameter and 6 stationary plates 5½ feet long. The hard rubber for this machine is of a specially



LARGE WAITE & BARTLETT STATIC MACHINE.

fine high grade, made by the Butler Hard Rubber Co., of New York. It was necessary to get the best there was going, for the machine delivers a 20-inch spark.

THE GREAT WESTINGHOUSE SWITCHBOARD AT THE WORLD'S FAIR.

In our issue of April 26 we gave a view of the great Westinghouse switchboard in Machinery Hall which controlled the enormous plant of alternators ranged on the south side of the building. In order, however, to enable our readers to obtain a thorough understanding of the operation of this board we give below a detail description of the method of wiring and connections which display not a little ingenuity.

It will be recalled that to transmit the energy necessary for the lighting of buildings and grounds as well as for power purposes the Westinghouse Company had in operation in Machinery Hall 12 double alternators developing 400 amperes at 2,000 volts. Each double dynamo consisted of two entirely separate machines, electrically speaking, while mechanically the two fields were mounted on the same base and the armatures had their coils intersecting so as to obtain a difference of phase of 90 degrees, both being mounted on the same shaft. Each half machine therefore, had a capacity of 200 amperes at 2,000 volts. This gave a capacity of 16,000 lamps per dynamo. Besides these, there were two others of 4,000 light capacity each, developing 100 amperes at 2,000 volts. The alternations of the large machines were 7,200 per minute, and of the smaller ones 16,000. The total lamp capacity of this installation, taking no loss into consideration, was 200,000. The dynamos were separately excited and compounded for constant pressure at the dynamo terminals; this was accomplished by two series transformers forming a part of the rotating armature, the primary being in series between the lines and armature and the secondary forming a closed circuit with a part of the field winding into which the current is sent after having been commutated.

For separate excitation there were three exciters of 100 h. p. each, compound wound, generating current at 250 volts pressure, direct connected to Westinghouse engines running at 300 revolutions per minute.

The switchboard, arranged in two tiers, was divided into three distinct parts, viewed from an electrical standpoint. There was (1) on the lower left-hand tier the huge controlling board and the exciter board; and (2) to the right of these the generator board, while (3) the whole upper tier was devoted to the circuit or feeder switchboard, containing the terminals of the outgoing circuits.

The exciter board occupied four of the panels into which the board was subdivided. One of them was kept in reserve for an increase in capacity. The diagram Fig. 1 illustrates the connections of one of the exciters, that is, the devices of one panel, as they were required to control these dynamos.

Beginning at the top there were mounted on the panel at 1, five 50-volt lamps connected in series across the brushes of the exciter. The current then passed through the ammeter 2 to the circuit breaker 3, shown closed, and thence to a three-pole switch, shown open. Connection was then made to the + and — bus bars 5 and 6, the equalizer bar being shown at 7. At the point 8 a there was inserted a voltmeter with movable circuit contacts to allow the testing of the dynamo's potential before connecting it to the bus bars. The total current taken from the bus bars was measured at the ammeter 9, the station voltmeter being placed at 10. The leads going to the field windings of the alternators are indicated at 11 and 12; 13 being the exciter field resistance. 14, 15 and 16 represent respectively the shunt, series and armature winding of the exciter.

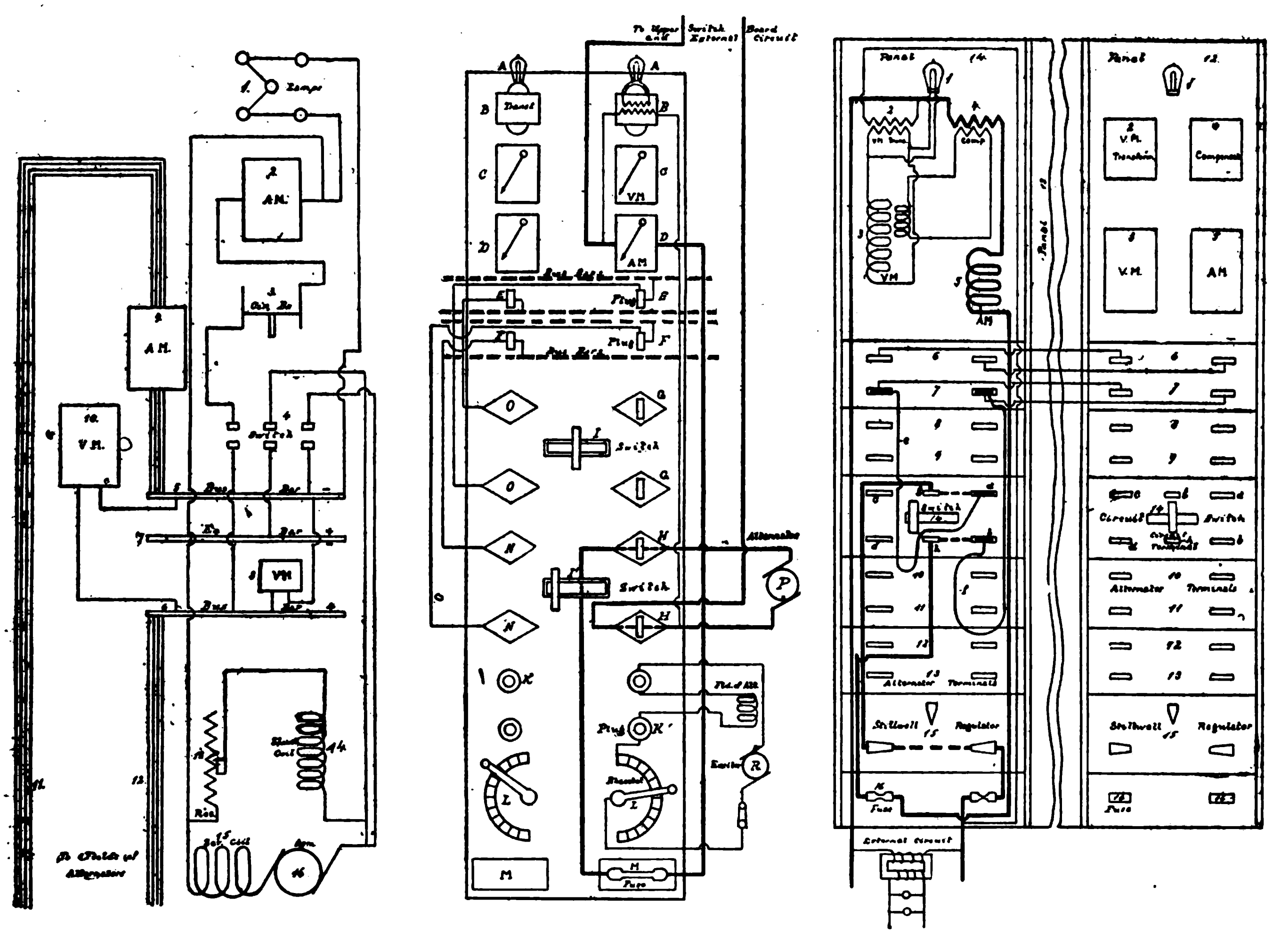
To the right of the exciter board there were 13 panels constituting the generator board. Each panel as is shown diagrammatically in Fig. 2 had instruments and switches for two separate circuits, or a double machine, and was arranged as follows. At A there were two pilot lamps supported upon and supplied by two transformers B, together with corresponding voltmeters C and ammeters D. E E and F F represent the plugs for the bus-bars which are represented by dotted lines. G G are the dynamo terminals of each half (independent) generator, and H H the terminals of the other half. I and I′ are the circuit closing switches for both halves of each machine. The plugs for closing the field circuit are shown at K; L L are the rheostats and M M, fuse blocks; N N and O O the terminals of the bus bars.

The complete circuit of one panel is as follows: Alternator P, terminal H, switch I, fuse M, ammeter D, upper switchboard and line, back from line, upper switchboard, lower switchboard, terminal H and back to armature P. If at any time the circuit now fed by the alternator P should have to be supplied by another dynamo, it is done without interruption of current supply, by plugging H H and F F on the dynamo panel which is going to be used, whereby current is not only supplied to its own line, but also to the bus bars (indicated by dotted lines) behind the board to the terminals N N of the panel of our diagram. Switch I′ is then thrown over to the right, connecting the circuit to terminals N N on the left side behind the board, disconnecting at the same time dynamo P.

The bus-bars from the dynamos extend to the upper or distributing board, and here the capacity is divided into two equal parts by extending the bus bars of one-half the dynamo capacity over the left half of the board and the other half by another set of bus bars over the right hand half. However, one set of bars is provided which extend the whole length of the board and these have no connection with either line or dynamo. Their purpose will however be understood from the following.

The large feeder board, shown in Fig. 3, contains 40 panels for 40 circuits. All bus bars are so arranged, that all the even panels are directly connected, and all odd ones are similarly connected. Each panel contains: 1. A pilot lamp connected to voltmeter transformer; 2, a voltmeter

transformer connected across the line; 3, voltmeter; 4, compensator having one of its windings connected in series with the line and its secondary adapted to demagnetize the voltmeter; 5, amperemeter; 6, bus bars or relay unconnected to line. 7 to 13 are dynamo terminals coming up from the board below; 14 is a circuit switch for outgoing circuits; *g h* terminals of outgoing circuits; *a b* and *c d* are dead contact points which by plugging can be made the terminals of any dynamo desired; 15 is the Stillwell regulator; 16, the fuse blocks of aluminum. On this diagram the two panels have been marked 12 and 14 while 13 is shown broken away. On this diagram also the circuit of panel 14 with its terminals *g h* is connected by switch 14 to *a b* and these terminals are connected by flexible plug cables *e f* to dynamo 7. If it is now desired to change this circuit over to another dynamo, because the load is increasing beyond the capacity of the generator and it becomes necessary to disconnect one or more circuits from those supplied by this single machine, then the following changes are made.



FIGS. 1, 2 AND 3.—CIRCUIT CONNECTIONS OF THE GREAT WESTINGHOUSE SWITCHBOARD IN MACHINERY HALL.

Thus suppose it is desired to connect this circuit to the dynamo whose terminals are marked 13 on our diagram, then plugs *c d* on the panel 14 are plugged and the other ends of the plug wires connected to the terminals 13, thereby making *c* and *d* alive, which now represent the brushes or terminals of dynamos 13. The switch is now thrown to the right, disconnecting the circuit from the terminals *a b*, which represent the brushes of dynamo 7 and an instant later this circuit is connected to terminals *c d*. The operation is effected so quickly that the change is hardly noticeable.

This method of plugging and interchanging was only done on one-half of the board; when it was desired to connect a circuit on one side of the board with a dynamo connected to the other half of the board, then *c d* were plugged to the disconnected bars 6, which extend along the other half board, connecting 6 on the panel of the other half board to the dynamo to be used and then throwing switch 14 which disconnected dynamo 7 and connected the other whose terminals are brought over by means of relay wires 6.

Mention was made above that the fuses employed were made of aluminum. The strips, of proper size, were encased in lignum vitæ boxes and the blowing of a fuse left a scarcely perceptible trace. These fuses have proved exceedingly reliable owing to the fact that they are not attacked by the atmosphere, the contact always remaining bright.

AN ENGINE THAT "KEPT AT IT."

THROUGH the long months of Spring, Summer and Fall, the engines in Machinery Hall maintained their steady pace, and few more inspiriting sights could be seen than when, at nightfall, from one end to the other of the row of engines and dynamos along the south wall, they were all working up to capacity and sending out enormous quantities of light and motive power in every direction. There were, it is true, a few peculiar exceptions to this state of persevering industry, in the shape of engines made presumably to look at, but the crowds that flocked into the temple of the mechanic arts showed very plainly how great is the fascination of machinery in motion.

That a good record had been made was thoroughly well appreciated by some of the engine builders, and on Oct. 30, the Westinghouse people put up a neat placard on one of their handsome single acting high speed compounds to the following effect: "This engine has made 35,896,500 revolutions to date, without stopping, Oct. 30, 10.15 a. m. It turns 5 times every second,—83 days, 2 hours, 15 minutes." The engine was still serenely at work when the Fair nominally closed.

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VOL. XVI. NEW YORK, NOVEMBER 8, 1893. No. 288.

THE LESSON OF THE INTRAMURAL.

THE best facilities for travel within the World's Fair grounds were those furnished by the Intramural elevated electric railway, winding around just inside the palings, from one end to the other, very much like a big "C" with a curl at each extremity. The line consisted of close upon 15,000 feet of double track and nearly 2,000 feet of single track. Trains ran ordinarily at 4 minute intervals and usually consisted of the motor car and three trailers, all four carrying passengers. All the cars were open, and all the seats were placed across the car, back to back, entrance being made by low doors which slid open or shut, all at the same time. The heaviest train loads were taken up or discharged with wonderful rapidity. As is well known, current was supplied to the motor cars by third rail.

The record of such a road as this is surely of interest to every large city in the country, and we are glad to be able to record the fact that the service was from first to last an enormous success. No fewer than 6,000,000 paying passengers were carried, and there was not a single accident. On Chicago day the total ran up to 125,000 passengers for the single day; and there were many other days when the figures reached 70,000 or 80,000. The service was smooth, regular and punctual, and the capacity of the road could easily have been increased had it proved necessary. The figures of operation are being carefully worked out, but they will show an economy beyond dispute. After such a brilliant demonstration, it is impossible for any man to declare that elevated electric roads will not work; and it is high time that such roads were availed of to relieve the congestion of passenger traffic that now prevails in every large American city, morning and evening and holidays all the year around. Moreover, it is high time that steam locomotives on elevated roads within city limits were arbitrarily ruled off the track. One could always sit in the Intramural cars and enjoy the fresh, free air without any stain to clothing or any soot or smoke flying in one's face; yet only a few yards away the open cars of the Illinois Central were crowded with passengers approaching or leaving the Fair, who were often harassed beyond endurance by the sulphurous, sooty clouds from the locomotives. The New York Elevated to-day is similarly a nuisance, chiefly, perhaps solely, on account of the smoke, soot, oil, ashes, drippings, etc., that it distributes lavishly all the way from the Battery to the Baseball grounds; and there is no longer any reason or any excuse for it. We watched personally the Intramural, day in and day out for six months together, riding sometimes half a dozen times in a single day, and never once did we see the slightest accident, trouble, confusion, or annoyance to any passenger. The motion of the cars was pleasant, and the motive power gave absolutely no sign of its presence. There were probably details to be improved, and that will be improved when new roads are equipped as they are soon to be; but the system as a whole is an unqualified success.

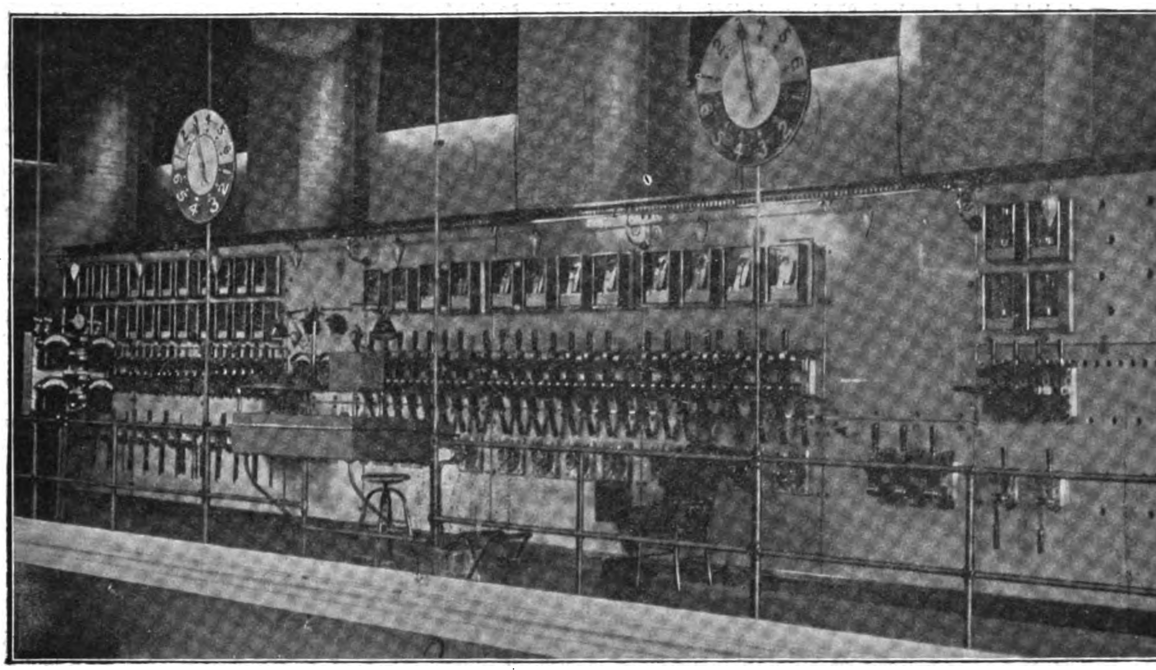
We could wish, as loyal New Yorkers, that this city or Brooklyn were the first to adopt the new method, but once again Chicago seems to be ahead, for news comes that the Northwestern Elevated Railroad Company has been formed, with a capital of $15,000,000, to operate such a road from Chicago out Evanston way. The directorate includes Mr. Frederick Sargent, recently the electrical and mechanical engineer of the Fair, and we understand that he will have a large share in the work of construction. Is New York never to have any of these modern conveniences and blessings that Chicago and Liverpool find within such easy reach?

THE TESLA ELECTRICAL OSCILLATOR.

ON another page we give a brief description of one form of Mr. Tesla's mechanico-electric oscillator, which formed part of his exhibit in Chicago. It would be hardly possible at this moment to foresee the ultimate effect which this latest work of Mr. Tesla will have upon the practical development of the electrical industry. Mr. Tesla is very sanguine, and if only part of his hopes are realized, its importance will not be long in making itself felt. The production of electrical currents in general with simpler apparatus than heretofore employed, and to all appearances with a more economical one, is certainly an achievement to be hailed by all who have the welfare of the industry at heart; while the maintenance of oscillations of constant period which may now be obtained by Mr. Tesla's apparatus in a positive manner, without the objectionable, older methods, is a result which scientific men certainly cannot fail to appreciate. We are now on the eve of witnessing the carrying out of some of Mr. Tesla's ideas on a grand scale in the work at Niagara—ideas advanced more than five years ago—and we have cause to feel certain that practical results will shortly come of this latest work. We are thus strengthened in our conviction, long since expressed, that practical results will also follow in the line of economical light production, now that Mr. Tesla has provided more perfect apparatus for the investigation of the phenomena which are associated with his name.

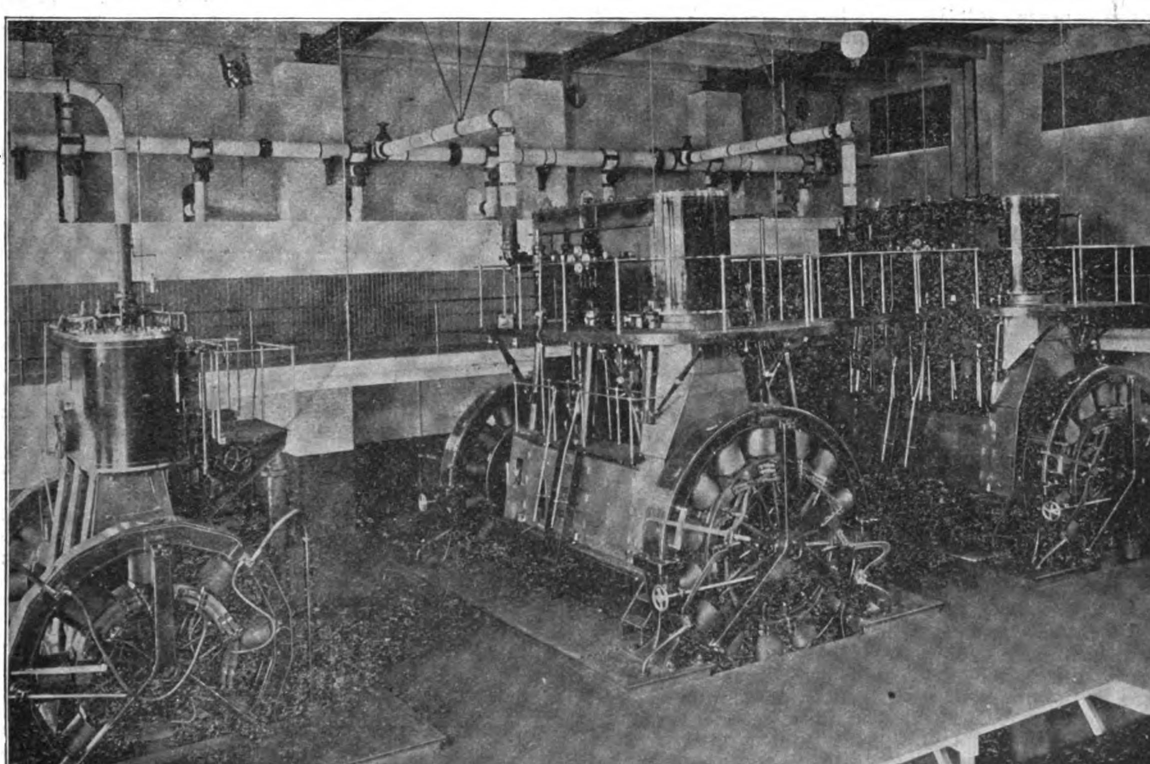
THE NEW SAN FRANCISCO EDISON STATION.

In July, 1891, the Edison Light & Power Company was incorporated with Geo. H. Roe, as president, the same gentleman who, full of hope as to the future of electric lighting, had founded the California Electric Light Co. in 1879. This Company, with an authorized capital of $3,000,000, was formed to operate the Edison incandescent system, and to take over all the rights and franchises of the California Electric Light Co. By this consolidation both the arc and incandescent lighting systems of the city were brought under one head, and at the present time the Company controls not only the Edison and Brush rights, but also the Thomson-Houston, Fort Wayne, Excelsior, and Schuyler rights. In addition, it holds the only franchises for overhead wires and poles and underground conduits for electric lighting and power ever granted in that city.



Switchboard in the New Edison Station, San Francisco, Cal.

The new company at once began to erect a new station, business having so largely increased as to render the older ones too cramped for satisfactory operation, and to place therein the machinery necessary to operate the Edison incandescent system. It was determined from the start to make this station absolutely modern in all its appointments, and no old machinery has found a place here. This station, known as station "C" was completed in 1892, and in its present state may be called a model of its kind.



Engine and Dynamo Room in the New Edison Station, San Francisco, Cal.

It has a present capacity of 44,000 incandescent lights, and provision has been made for an ultimate capacity of 87,000 lights. It is located on Jessie street, adjoining station "A," the two having a total frontage of 300 feet. It is a substantial structure of brick and iron practically fireproof, and covers an area of about 14,000 square feet.

The boiler-room is laid out for thirty 250 h. p. boilers, to work under a pressure of 165 pounds Above the boilers are located the large iron coal storage bins. From these the coal is fed through chutes to hoppers, which feed the mechanical stokers. These, in turn, force the coal up into the furnace from beneath and thus prevent the ingress of cold air to the boilers, while providing for the complete combustion of the gases, the coal being heated to a high degree before being actually burned in the furnace.

The engine-room adjoining is about 80 feet square, with a ceiling 37 feet high. Around the walls runs a gallery at a height of about 14 feet from the floor. The foundations for the engines are of concrete, 14 feet in depth, and the six engines cover an area of about 3,600 square feet. They have no connection with the building proper, but are entirely independent, and thus no jarring is noticeable in the station. The generating plant consists, at present, of four General Electric combination sets, *i. e.*, two 100 k. w. multipolar dynamos directly connected to an Edison triple expansion engine of the marine type, and six 200 k. w. multipolar dynamos each pair of which is similarly connected. Four more 200 k. w. machines will be put in later. The belted dynamo has no place in this station.

The switchboard, located in the gallery, is one of the largest and finest ever built. It is of polished marble, 57 feet long and 9 feet high. This board was described in detail in our issue of Jan. 4, 1893, before it left the factory for the West.

On the floor above the engine-room are the offices of the chief engineer and chief electrician, the laboratory, meter-room, draughting-room and repair shop. The laboratory is fitted up with the most modern devices for delicate electrical measurements, and is the standardizing centre for all electrical instruments on the Pacific Coast. The repair shop is equipped with tools to take care of any emergency, and all repairs and alterations are made there. The great distance from the electrical factories and consequent high freight rates, as well as loss of time in transit, render these precautionary equipments necessary.

A novel feature of the company's plant is a tunnel 8 x 6 feet, which has been constructed below low tide level, from the station to San Francisco Bay, for providing a supply of water for condensing purposes. The outlay for this finds its justification in the high price at which coal is sold on the Pacific Coast.

Summing up, the total boiler capacity of the three stations now operated by the company is 8,500 h. p.; the total engine capacity 7,700 h. p. There are 478 miles of wire in overhead circuits strung on 4,086 poles, and there are already laid 12¼ miles of Edison underground conduit. The Palace Hotel, of San Francisco, the largest hotel in the world, has recently shut down its isolated plant, and its 7,000 lights will now be supplied with current from station "C." This hotel is the largest individual consumer of electric current supplied from any central station.

The Edison Light & Power Company numbers among its stockholders many Eastern investors. It pays monthly dividends at the rate of 8 per cent. per annum, either at San Francisco or at the office of the New York Guarantee and Indemnity Company, New York. Its officers are George H. Roe, president; Gustav Sutro, vice-president; and J. E. Green, secretary. Although situated at the western extremity of the continent, this San Francisco plant may be considered as one of the best managed and best paying in the country.

A PARISIAN SCHOOL OF MAGNETISM.

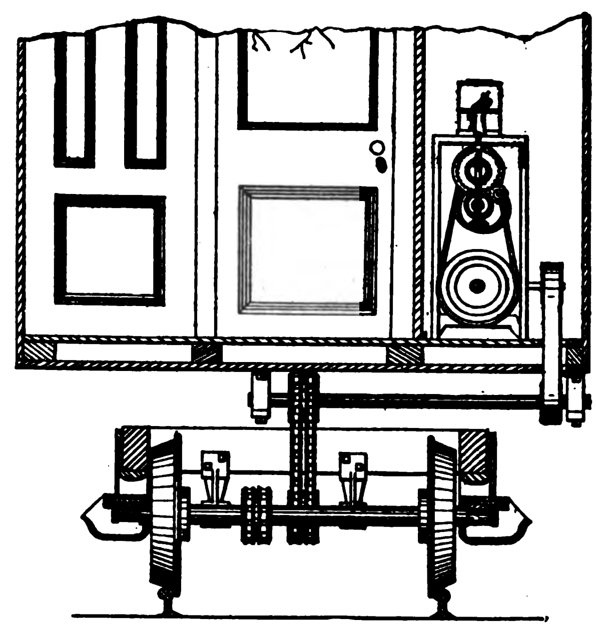
One of the newest institutions of Paris is a "Practical School of Magnetism," founded by the Magnetic Society of France, where, according to a correspondent of a London newspaper, "all branches of the occult sciences will be taught medical men and specialists." M. Durville, one of the directors of the new school, has given the following lucid explanation of its purposes: "I have the experimental certainty that magnetism is a vibratory mode of ether, viz., a manifestation of energy. People believed formerly that physical forces were distinct from one another, but within twenty years it has been proved that these agencies are linked by close ties of relationship. They all give rise to one another. In order to explain the action of these different agencies, scientists have recourse to the notion of ether, which we hold to be a fluid filling the entire universe, as well as the space between molecules of matter. The above principles have received general agreement, but scientists in general do not know that in addition to sound, heat and light vibrations there are others which give rise to a very powerful force—physiological magnetism. This is, in a nutshell, the whole theory of magnetism as we intend to teach it. It is a new theory, and in harmony with modern science we do not admit the existence of a particular force belonging to the human body of a fluid running from one being to another. The word fluid here is void of meaning. There is no fluid. There are only vibrations."

TRANSMITTING POWER FROM CAR AXLE TO DYNAMO.

The lighting of railway trains by electricity has become so common of late that it is not surprising to find many inventions springing up to improve present methods. There are three systems of electric car lighting, or rather three ways of obtaining current, in use; first, from accumulators replaced from time to time along the route; second, from a directly connected dynamo and engine, carried in one of the cars and supplied with steam from the locomotive; and third, from a generator driven from the car axle. The last method has always been unsatisfactory on account of the continual variations of speed to which the generator is subject, and also the reversal of its direction of rotation whenever the train backs.

To make this third method practicable, and to obtain a constant speed of the dynamo armature in the same direction, irrespective of the speed or direction of the train, Messrs. Morris Moskowitz and Samuel Young, of Newark, N. J., have devised the ingenious arrangement shown in the accompanying illustration, which represents the end of a car with the speed-regulating device connected with the dynamo, and the gearing on the car axle communicating its rotary movement to the regulator.

The action is as follows: To the one end of a governor shaft is secured a bevel wheel and meshing with this are two other bevel wheels loosely arranged on sleeves respectively secured on the shaft by means of a key. The ends of each sleeve form ratchet



Driving a Dynamo from the Car Axle.

wheels with teeth set in opposite directions, and the wheels provided with spring-actuated pawls set in opposite ways and adapted to engage with the teeth of the ratchet wheels. By this opposite arrangement of the ratchet teeth and the pawls acting in opposite directions, and also, owing to the fact that the bevel wheels are loosely arranged on the shaft, the governor shaft will at all times maintain its revolutions in the same direction, whether the car is moving forward or backward.

The regulation of speed is effected by means of two cone friction pulleys with an endless belt between them, whose position is regulated by a ball governor, so that the armature shaft is rotated at an approximately constant speed.

WORLD'S FAIR LAMP TESTS.

The incandescent lamp tests in Electricity Building ended Saturday evening, Oct. 28, when Prof. Thomas took the records away with him to Columbus to work out. Another series of insulated wire tests was to begin last week, but samples were slow in coming in. Reports on both series may be expected, it is said, during the present month.

Mr. Sidney Z. Mitchell, the District Agent in the far Northwest for the General Electric Co., was married on Oct. 25 at Trinity Church, Portland, Oregon, to Miss Alice Bell, daughter of Mr. and Mrs. John C. Bell.

ELECTRIC RAILWAY DEPARTMENT.

SOME PRACTICAL POINTS IN THE CONSTRUCTION OF UNDERGROUND FEEDERS FOR ELECTRIC RAILWAYS.[1]

BY DUGALD C. JACKSON.

UNDERGROUND construction may be divided into two general systems—"built in" and "drawing in" systems. The use of the first is not generally advisable. In the second system the most approved forms of ducts are iron gas pipe, cement lined iron tube, ordinary vitrified clay or terra cotta pipe and wood. Where obstructions must be avoided by making bends in the conduit, iron pipe is economical, as the pipe may be bent to quite a short radius without interfering materially with the drawing in of cables. When rigid materials, like terra cotta, wood, etc., are used, bends can be made only by using short sections set at a slight angle with each other. This makes an unsatisfactory job, and causes injury to the cables during the process of drawing in. When comparatively light feeder lines are to be carried, probably the most satisfactory conduit is ordinary cement or vitrified clay sewer pipe laid in concrete. This costs only about two-thirds as much as an iron pipe of equal capacity laid directly in the ground without any protection. The concrete protection is very important in the case of the clay pipe, and the extra protection from injury by street laborers' picks and bars afforded by a creosoted plank laid over the conduit well repays its cost.

For the purpose of drawing in the cables, manholes are required at frequent intervals. Large manholes with double covers may be made to cost from $100 and upwards, apiece, but for all ordinary electric railway purposes small holes, costing less than half as much, give entire satisfaction. Where feeders are led from the conduit to the trolley wire, they should be run through a small iron pipe leading from a manhole or a handhole to one of the railway poles. If the latter are of iron, the cable may be run up inside the pole to a watertight junction and fuse box. If the poles are of wood, the cables should be carefully protected by iron pipe. Where taps are led from underground mains to the trolley wire, an excellent arrangement which may be used under most circumstances is a small iron handhole in which the joint to the main may be made. From the handhole the tap may be led through an iron pipe to a watertight box on a pole, as in the case of a feeder.

A very important part of an underground system is the cable. A cable consists of three parts: the conductor, the insulation and the protective coating, each of which is essential to the usefulness and the successful working of the cable. The conductor may be solid in small sizes of wire, but for wires with a cross-section much greater than No. 4 B. and S., solid conductors are not sufficiently flexible to draw in without endangering the insulation. Since economy in the cost of cables dictates the use of large conductors, except in rare cases, stranded conductors must be the rule in electric railway cables. In laying down an extensive feeder system, it is economical to use one standard size of cable throughout, as far as possible.

The materials used in the best cables for electric railway service are india rubber compounds, more or less vulcanized, or compounds of various waxes, bituminous substances, and oils. The rubber compounds are usually applied directly as a covering to the wire, but the less staple bituminous compounds require some absorbent for a basis. This should be strong, soft and flexible, with little fuzz and be a good insulator when dry. Cotton, paper, hemp and jute all serve in this capacity. Cotton probably answers the requirements best, though paper is an excellent and inexpensive insulator and when the cable is made properly it serves admirably. Unless the compounds used with paper serve to soften it, however, the paper is likely to crack and cause trouble.

No cable with a fibrous insulation can be made moistureproof, and hence an air tight sheath is resorted to. Great care is necessary that no flaws exist in the sheath, which is invariably made of lead, as a single pinhole may cause the destruction of a considerable section of cable. Rubber insulation should always be used when a cable is likely to be continuously submerged, proper care being taken to assure the integrity of the covering. The fibrous cables are, in general, of less first cost than rubber cables, and are therefore, largely used. Some of them have been under operation for eight years without deterioration, and under favorable conditions they should last not less than 25 years.

An electric railway has no reason to suffer much from the electrolytic effects of its own return currents on the lead sheathing of its cables since properly connecting the lead to the rail at intervals and to the ground terminal of the dynamo, will give the current an opportunity to get off the lead without much chance for electrolysis. To protect the lead from destructive chemical action, it is often alloyed with about three per cent. of tin, or a small percentage of antimony, but it is difficult to get a uniform alloy, so that tin-plating is often resorted to. The latter makes the cables slip easier when drawing in, but it is doubtful whether the tin does not become so scratched in the process as to make it useless as a chemical protector. As a matter of safety, however, it is well to both alloy and plate the lead.

The moulded joint is cheap, but it is not as reliable as the sleeve joint and, therefore, is not to be generally recommended. Watertight boxes should also be used for terminal boxes. To make the boxes tight the cover should screw up against either a gasket or a scraped surface, and a ring projection in which the cable sheath may be wiped should be made at the point where the cable enters. The ends of fibrous cables should be carefully paraffined or taped with rubber tape. Wherever a connection is made from cable to overhead wire a first-class lightning arrester should be placed.

If properly installed under fair conditions, experience seems to show that five per cent. is sufficient allowance for depreciation of cables and conduits. The cost of conduits of iron pipe laid in concrete in unpaved streets is, in cents per running foot, about $25+24d$, where d is the number of ducts. To this must be added the cost of repaving, any charges that may be required on account of special work, and from 12 to 20 cents per running foot of conduit to cover the cost of manholes. Single ducts of sewer pipe may be laid for about 35 cents per running foot, not including manholes or repaving. Wooden conduits may be made to cost less. The cost of cables depends on the size of the conductor, the thickness and quality of the insulation, and the thickness of the lead. A No. 0000 cable, with insulation about $\frac{5}{32}$ of an inch thick and covered with $\frac{3}{32}$ of an inch of lead, may be ordinarily laid in the conduits for between 50 and 60 cents per running foot, unless an excessive amount of special work is required. Even for heavy underground lines the annual cost (interest+depreciation+maintenance) is three and four times that of lines of equal capacity placed on good overhead construction. In many cases this means a considerable increase in the cost of carrying passengers. How far increased reliability in service and satisfaction to property owners can be counted against the increased cost can only be decided in each individual case. In many cases it means bankruptcy for the company, but in a smaller number it means a manifest gain.

1. The Paper, of which this is an abstract, was prepared to be read at the recent meeting of the American Street Railway Association, but the author was unable to be present in time. The Executive Committee ordered its incorporation in the proceedings.

ELECTRIC SHOE BRAKES.

I HAVE read with much interest Mr. Edward H. Johnson's interesting articles on electric car control and brake action, and my attention has been particularly attracted by Mr. C. H. Haskins' letter relative to this subject in your issue of October 25. While by no means an authority on "broom stick trains" in general, I cannot withstand the temptation of calling attention to certain points relative to Mr. Haskins' letter which, to my mind, seem to bear directly on this subject.

In the first place, Mr. Haskins suggests that no patent can be obtained on a device such as that which he describes, which is a simple electric shoe brake. I think I can give a better reference than Mr. Haskins' mention of the English patent for a brake to be applied to steam roads. I would call your attention to U. S. Patent No. 423,400, dated March 11, 1890, wherein a simple electric shoe brake is clearly shown and claimed. This is the patent of Mr. Detlef C. Voss, of Medford, Mass. In his first clause Mr. Voss distinctly claims an electric shoe brake broadly.

It occurs, however, to my untrained mind that singularly disagreeable results would follow dependence upon any electric shoe brake in case of the loss of the trolley on a heavy down grade, an occurrence which I have witnessed not infrequently. Under such circumstances I should prefer to participate in such an experience from the sidewalk.

It occurs to me, however, that a possibly efficient safety brake or auxiliary brake could be constructed on the rat trap principle; a brake in fact which should be set and which should depend only upon electricity for its release. A brake, I believe, might be constructed which should under certain circumstances release by reason of currents induced by the back kick through the field on the sudden stopping of the current, although I am scarcely prepared to elaborate such a scheme. Obviously it would hardly do to have such a brake released every time the motor was shut off or the trolley became disengaged.

CARYL D. HASKINS.

BOSTON, Mass.

TROLLEY CAR BRAKES.

A WORD in regard to the subject of trolley car brakes and Dr. J.'s diagnosis of the case in THE ELECTRICAL ENGINEER of Oct. 25. With all due respect for the doctor's long experience and universally acknowledged good judgment in such cases, if "by means of the motor alone," he means to stop the car by the armature acting through the pinion and gear wheels, I am afraid our experience in the future will be as in the past,—a lot of stripped pinions and broken gear wheels.

I believe that Mr. Crissey's suggestion to suspend a brake shoe from the car frame to be pressed against the rail, to be a step in a more practical direction, and one that could be applied at minimum expense. But I would suggest that instead of using the air or vacuum brake to control the track shoe, to use the present hand brake, because, instead of the sharp jerk and strain on the car from the air or vacuum brake, the hand brake could be applied more gradually and I believe fully as effectively. A generous use of the sand boxes attached to most of the new cars sent out materially adds to the satisfactory results attainable from track brakes, especially in damp weather.

As to electric brakes, if solenoids can be so arranged as to make the track shoe a magnet, it would be so much the better for the adhesive and braking power of the shoe, but I am afraid an electric brake, pure and simple, would be a snare and a disappointment, because when needed the most, the trolley pole would have jumped the wire or have been pulled off by some lunatic (as a conductor told me a short time ago would be his first move) in order to stop the motor.

As to wheel brakes, I believe the experience of all having charge of them, especially on trolley cars, has been about the same, that is, the better your brake works, the more chances your motorman takes and the quicker you have flat wheels; in fact, this seems to be one reason why superintendents don't insist more strongly on the present brakes being kept in better order—new wheels cost money!

L. A. MCCARTHY.

BROOKLYN, N. Y.

A WEAK POINT IN MAGNETIC TRACK BRAKES.

THE magnetic track brake mentioned in the discussions now open in your columns, would appear to be faulty, for the reason that while the force is exerted in a manner calculated to produce the results sought for, such force is expended in a wrong direction, namely, perpendicular to the track itself, and practically adds to the weight or downward force of the car, but does not materially prevent the car sliding or slipping in the direction of the track. A force of many pounds may be exerted in the effort to pull the armature from a horse shoe magnet, while but a comparatively slight one will detach it by sliding it off sidewise; the frictional contact between the two being very small.

Under the circumstances, would it not be well to strengthen the overhead construction by suitable plates, and place these powerful magnets *on top* of the car. Then when a person makes a sleeping place of the car track all that will be required, as the car reaches the obstruction, is to turn the circuit into the magnets, —when the car will gracefully rise from the track and attach itself to the trolley wire. Thus by sliding contact with the plates, owing to the momentum of the car in motion, the obstruction would be cleared; and the current turned off at the proper moment would cause the car to resume its proper place upon the track, and enable the sleeper to continue his slumbers undisturbed and avoid "mussing the car all up."

For the want of a better name at present, this plan might be called "The Yellow Dog Motor Trolley Car Protector."

C.

MISCELLANEOUS.

THE LEONARD ELECTRIC PUMP.

BY H. WARD LEONARD.

ONE of the most difficult problems which confronts the electrical engineer is the operation of pumps by electric motors. It is necessary to start the motor under full load, and frequently under conditions such that a large column of water must be put into motion—the inertia of which is very great. Heretofore electric motors for this purpose have been supplied with the rheostat in the armature circuits of the motor, and the rheostat must necessarily be quite large and expensive, and it usually occasions a great deal of trouble due to the sparking of the contacts and burning out of the coils on account of the excessive loads.

It is desirable and usually essential that the motor should be operated continuously over long periods at different speeds. For instance, in the case of pumping the water out of mines the amount of water to be handled varies greatly, and it is dependent upon the rainfall and other similar factors, so that at certain times it may be necessary to run the pump at full speed continuously. At other times when the inflow of water is much less, it is desirable that the pump shall be operated continuously at just such a rate as to pump the water from the mine as rapidly as it comes in. The operation of the ordinary electric motor under conditions of full torque and at different constant speeds in this way is attended with a great many troubles, for it is practically impossible to maintain a constant speed on the motor with a large portion of the rheostat in circuit. When a motor has a large amount of resistance in series with it, and is operating under full torque, any considerable change in the torque will occasion a wide change in the speed, so that to run the motor at a reduced speed by means of a rheostat, it is necessary to continually adjust the rheostat, and the efficiency of operation is necessarily quite low, as a large portion of the total energy is wasted in the heating of the coils at the rheostat.

By means of the Leonard system of control for electric motors these difficulties in the operation of a pump are entirely done away with. In the Leonard system the generator which supplies the motor and the motor itself are identical in every way. The motor field is kept constantly excited from an outside source, such as the incandescent light circuit, or a small exciting dynamo. The armature of the generator and motor are connected together, and form an entirely distinct, separate electric circuit. The field of the generator is supplied with current from the same source as that which supplies the motor field, but a field rheostat is placed in circuit with the field of the generator, so that the current around the field magnet of the generator, and consequently the magnetic field of the generator, can be varied at will. This rheostat is extremely small as it only controls about $1\frac{1}{2}$ per cent. of the total amount of current produced by the generator, and consequently no trouble is met with as regards sparking or burning out of this rheostat, and it is very small and cheap. The motor is connected by gearing to a crank shaft, which connects by means of the connecting rod to the pump plunger. To start the pump the rheostat in the field circuit of the generator is placed so that all of the resistance is in circuit; consequently a very weak magnetic field is produced in the generator. The armature of the generator being driven by means of steam, or other power, at a constant speed produces a low voltage at the brushes of the generator. Let us suppose that the generator and motor are wound for 250 volts, both machines being shunt wound. When the magnetism of the generator, by adjusting the rheostat in the field circuit, becomes sufficiently strong so that about 20 volts are produced at the generator brushes, the current flowing in the armature circuit of the two machines, and passing through the armature of the motor in its fully excited field, will produce a sufficient torque to cause the motor armature to commence to revolve very slowly and very smoothly, and if the controlling rheostat be left in that position the motor will continue to drive the pump very slowly, but under full torque; no sparking of any kind will occur either at the brushes of the generator, the brushes of the motor, or at the rheostat. By cutting out another step of resistance in the field rheostat of the generator we increase slightly the current around the field of the generator, and consequently increase the volts produced by the generator slightly. This will cause a temporary increase of the current in the armature of the motor, and consequently will accelerate gradually the speed of the motor and the pump driven by it. By gradually cutting out step by step the resistance in the field circuit of the generator we gradually increase the voltage of the generator, and consequently the speed of the motor and the pump until full speed of the pump is reached. Each particular position of the rheostat placed in the circuit of the generator field represents a definite constant automatic speed for the motor and the pump. It will be noticed that there is no waste of energy in operating the pump by this method at slow speed; when the generator is producing 25 volts and hence requires but $\frac{1}{10}$ of its full power, the pump will run approximately at $\frac{1}{10}$ of its full speed, whereas by the rheostat method just as much energy is required to run it at $\frac{1}{10}$ of its speed as at its full speed.

By the Leonard method of control, the speed of the motor will vary in proportion to the volts produced by the generator, and the torque exerted by the motor will vary in accordance with the current produced by the generator, and since the speed multiplied by the torque represents the work the pump is doing, and since the volts multiplied by the amperes of the generator represents the energy required by it, it is evident that the power required by this method is always proportional to the work being done by the motor.

With the Leonard electric pump it is very easy to arrange the apparatus so that the rate of pumping by the pump will be always automatically proportional to the inflow of water into the mine. This may be done by placing a float in a sump in the mine and connecting this float with the lever of the rheostat in the generator field circuit, so that as the water rises in the sump the resistance of the rheostat is cut out, and the pump is made to operate faster, and as the water in the sump lowers, the resistance of the rheostat is put into circuit, and the pump is made to

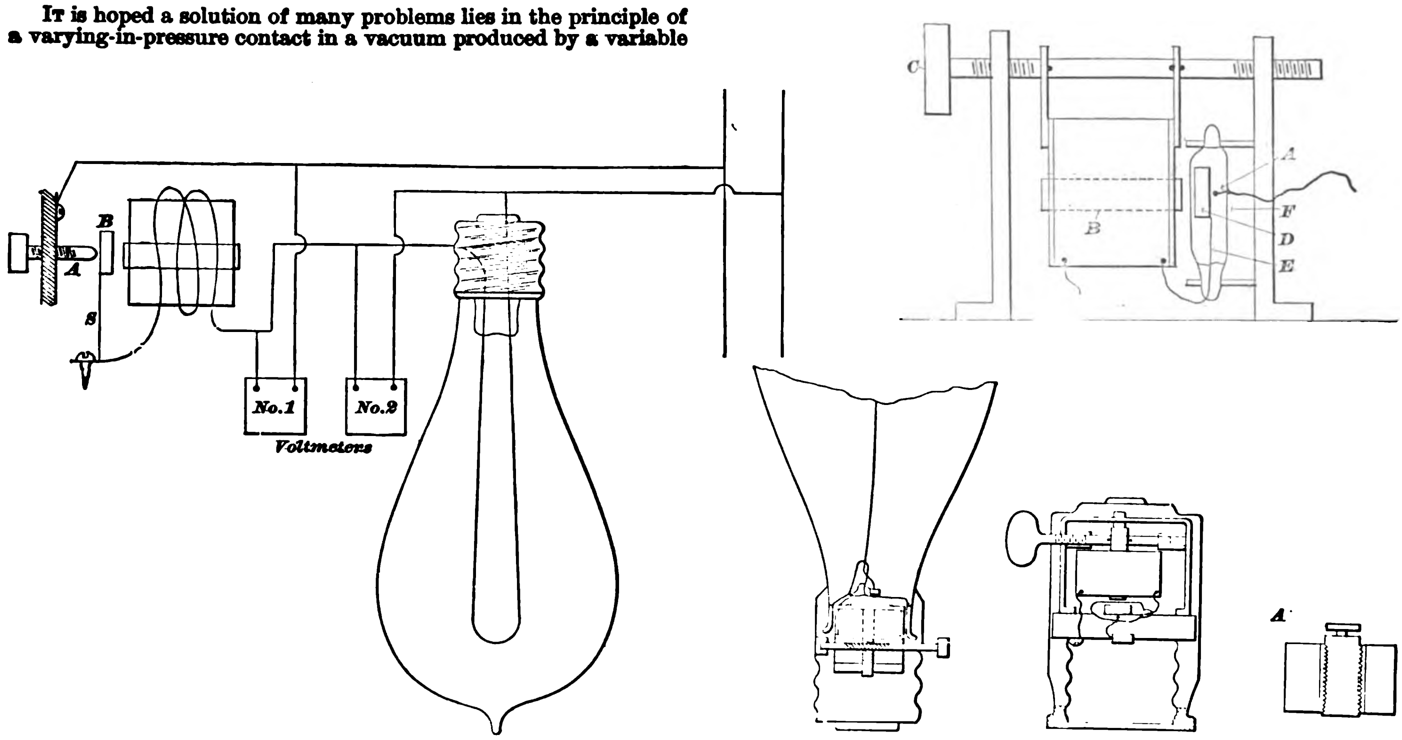
go slower. By this simple means the pump will be continually in operation at such a rate of speed as to hold the water between any two desired levels. With the ordinary control of a rheostat in the armature circuit the rheostat merely enables us to bring the motor up to full speed, and the pump must either run at full speed or remain at rest, which is not satisfactory, as it is of the utmost importance that the pump may be run continually at any desired speed, from the slowest speed up to full speed and under any variation of torque which the practical conditions demand.

Another method for varying the speed of a motor for operating a pump without the use of rheostats is that of using a commutated field for a motor. This necessitates the use of a much larger motor than would be required by the use of the Leonard method, so that the first cost is very materially increased. The range of speed is not nearly so wide as may be obtained by the Leonard method, and since the full speed of the pump is obtained when it has the weakest field, there is a great tendency to sparking upon the motor at full speed, as it is not possible to operate a pump at an extremely slow speed, which is desirable in starting up. To overcome these difficulties, it is necessary to install a very much larger and more expensive motor than would be required by the use of the Leonard method.

A NEW METHOD FOR THE CONTROL OF ELECTRIC ENERGY.[1]

BY D. McFARLAN MOORE.

It is hoped a solution of many problems lies in the principle of a varying-in-pressure contact in a vacuum produced by a variable



Figs. 1, 2, 3 and 4.

magnetic field, and it is doubly valuable in that it can be applied both to the alternating and the direct current. One of the simplest forms of apparatus designed for meeting these conditions is shown in Fig. 1. The varying-in-pressure contact is shown at A, caused by the variable magnetic field due to the movement of the magnet B by thumb screw C. The evacuated bulb F contains the armature D, supported by spring E, permitting it to vibrate rapidly, producing pulsations or interruptions of the current. The rate of degree of these interruptions depends on the strength of the magnetic field surrounding the armature (in this case acting through the glass), which in turn depends on the distance of the magnet from it, varying inversely as the square of the distance. Varying the magnetic field, and therefore the pressure on the contacts, changes the amperes and volts of the current passing through the device. With properly designed apparatus the movement of the armature is so slight that to all appearances one would think it at rest. In the discussion of this method of current control, let us select that form of translating device known as the incandescent electric lamp. Fig. 2 is a diagram showing the action of a vibrator in series with a lamp, without the contacts in a vacuum.

Its action is as follows:—Contact made at A; current flows through magnet and armature is attracted, breaking the circuit; magnet loses its power and spring S again closes the circuit.

Fig. 3 shows the device as applied to each individual lamp, and it will be noted that in this case the vacuum of the lamp is utilized for the vacuum of the contacts as well. The size of the armature is made as light and small as possible not only on account of the general law of all mechanical construction, viz., make moving parts as light as is compatible with strength so that the position of the lamp will have no effect on the incandescence of the filament, but to minimize the amount of residual gas in the metal composing the armature, as any foreign gas will be detrimental to the filament.

In Fig. 4 a socket of ordinary dimensions is shown constructed on the same principle. A socket of this kind can be adjusted to regulate a lamp of almost any candle power within limits.

In both of these instances the movement of the magnet produces the regulation, but it is evident the result would be the same by either the movement of the vacuum or the core of the magnet, as shown at A, or by throwing in and out coils of the magnet. The filament emits continuous light with an illuminating power corresponding to the rate of vibration of the armature. When the armature is not within the inductive distance of the magnet, it is at rest and the filament being in circuit, the light is at its maximum. An attachment to the means for adjusting the magnet is used to break the circuit when it is desired to extinguish the light. Tests show that the volts and amperes vary directly with the light. This is apparent from the following table, a 16 c. p. lamp being used:

Amperes.	Voltmeter No. 2 (see Fig. 2).	Voltmeter No. 1.
.42 full c. p.	115	0
.30	84	31
.17	52	63
.11	35	80
.07	20	95
.04	15	100
.03	10	105
.02 just visible.	5	110

Still lower readings were taken, but below .02 ampere the heating of the filament was not discernible by the eye.

As shown by the readings of voltmeter No. 1, the more rapid the vibrations, the more E. M. F. is required by the contact breaker. Inasmuch as the contacts are in a high vacuum they will remain bright and effective, and the light is regulated without the use of bulky resistance. Again, with this arrangement the current is not thrown on or off the filament suddenly, thus increasing its longevity owing to more gentle treatment. The slight sparking in lamps individually regulated will use up the residual oxygen in the

1. Abstract of a Paper presented at the 79th Meeting of the American Institute of Electrical Engineers, New York, September 20, 1893.

evacuated bulb of the lamp, thus making it more perfect, and lengthening the life of the lamp.

It was curious to note that practically as well as theoretically a suspended armature is never perfectly at rest. When a photometrical test would probably decide that the lamp was burning at full candle-power, and the screw A pressing the armature B as tightly as the construction of the apparatus would allow against the core of the magnet, if a sounding board is brought into requisition the vibrations of the armature are plainly discernible.

Now let us again refer to Fig. 2 and note the changes as the lines of force acting on the armature vary.

The vibrator is in series with the lamp, because if in shunt, the action is reversed and the liability to short-circuit makes it impracticable.

(1) A and B separated, lamp out. (2) A and B in contact, lamp full, because B is not in magnetic field of magnet. (3) Continue to advance A, B enters field, rapid vibrations commence and lamp suddenly becomes dim. (4) Continue to advance A, lamp gradually brightens until full candle-power is reached.

Fig. 5 shows these periods reproduced diagrammatically. It will be noted that there are two periods where the lamp can be regulated. Period 2—3 is of too short duration for practical application, however, and by the proper adjustment of the spring can be done away with entirely. Period 3—4 covers the greatest range in candle-power and should be used. The delicacy of the spring supporting the armature determines somewhat the position of point 3, that is, the minimum in candle-power of the filament.

trodes, high resistance, sheath of copper around bobbin of magnet, metal foil between layers of magnet, separated coils, etc., are all familiar methods.

It is the C. E. M. F., or automatic "choking effect," of the alternating current that admits of its beautiful control without loss, such as is sustained by controlling the direct current entirely with ohmic resistance. With this method under consideration, the C. E. M. F.'s of the pulsating or intermittent direct current are taken advantage of. That is, both those in the arc and in the magnet. It appears that the main advantage (without some disadvantages) of alternating systems can be transferred to the continuous system by using in each socket, or on every circuit, varying pressure contacts, causing an interrupted current of any desired voltage, thus increasing the possibilities of this system to an enormous extent owing to the immense saving in copper conductors.

If an appurtenance of this construction is operated by a centrifugal governor attached to a motor, the best results as regards economy and regulation can be obtained as the voltage will then vary directly as the torque, and the electric energy required will be proportional to the power developed. Owing to the minimum size of this device it can be made an integral part of the motor. The salient disadvantages of a resistance box that can now be overcome by constructing apparatus as described, are, first, size; second, weight; third, susceptibility to changes in temperature, that is, variation in resistance; fourth, poor contact caused by the burning of clips and loosening of wires; fifth, heating and the

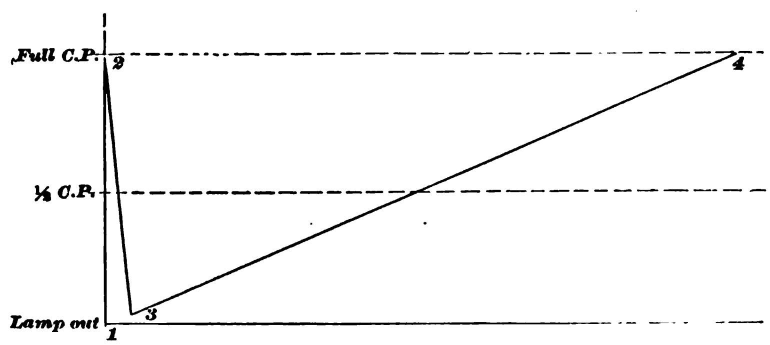


FIG. 5.

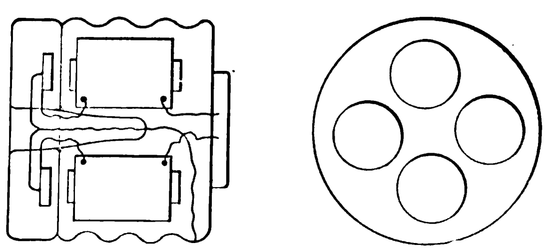


FIG. 6.

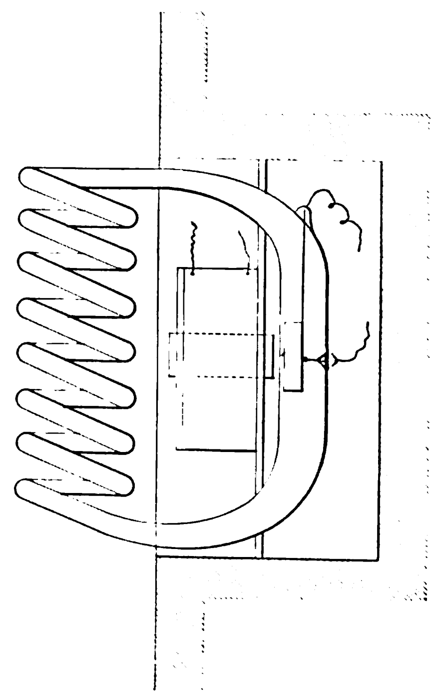


FIG. 7.

The voltaic arc appears between the terminals of a source of electricity. In the case of the arc lamp, it consists mainly of volatilized carbon. The electrodes are therefore consumed, first by actual combination with the oxygen of the air, second by volatilization. The ohmic resistance of the arc increases with its length and decreases with its area of cross-section. Polarization sets up C. E. M. F., and the extra current produced by self-induction retards magnetic action and causes more sparking. With metallic electrodes the color of the arc is characteristic of the metal and is of greater length for the same current than that formed between carbon electrodes. To cause electrical vibratory motion, the current must either be greatly weakened or broken. This will cause sparking which, when the life of the contacts is taken into consideration (even though they be in vacuo), should be reduced as much as possible. However, further experimenting may prove the possibility of current regulation by varying the length of the arc in vacuo by means of an exterior magnetic field. Also the construction of a true incandescent arc lamp on this principle.

Sparking can be relieved in many ways: (1) Subdivide the current as much as possible. (2) The more rapid the vibrations the more rapid the make-and-break, and consequently the less the spark. To cause rapid vibrations, the point of application of power should be as close to the point of oscillation as possible, or the point of contact should be as far from the point of oscillation as possible.

Magnetic blast, condensers, non-sparking metals, unlike elec-

great fire risk consequent thereto. The new method is certainly unique, and its application will be the means of affording a great convenience under many circumstances. Owing to its constancy, due to its non-susceptibility to temperature changes, it can be adopted, when the adjustment screw is used in connection with a graduated dial, with great facility as an electric gauge.

Experiment shows that the continuous sparking (though slight) of the contacts in a vacuum, sets in motion the ether molecules causing that beautiful soft blue phosphorescent light similar to that produced by Geissler tubes. Now by increasing this effect, a light may be produced of greater efficiency than is now obtained by the incandescent filament, which is very inefficient. This method of lighting is a radical departure from anything heretofore proposed, as it will be producing phosphorescent light due to ether oscillations without the use of an alternating current (although there is no reason for not using it) at high tension, with expensive and impracticable condensers and transformers. The value of this system will be more clearly discerned when it is remembered that the elements above mentioned as being done away with, are those which stand in the way of phosphorescent lighting becoming commercial at present.

If any inert gas, such as nitrogen be substituted for the vacuum, the phosphorescent effect will most likely be intensified on account of more vigorous molecular action, but the life of the electrodes may be shortened. It might be advisable with metallic electrodes to use carburetted hydrogen because when decomposed it would not affect the metal. Fig. 6 shows one form

of phosphorescent lamp complete, its size a little larger than the base of an ordinary lamp, the c. p. being developed by multiple contacts.

A matter of great importance in the design of a lamp of this description is the form and nature of the evacuated space, partially determined by the melting point of the glass, also whether it is advisable to use double or even triple bulbs, one within the other. Fig. 7 denotes one of the many forms of lamps that suggest themselves, but experience only can prove that which is most efficient. The study of this branch of physics and of these highly interesting phenomena brings to our minds innumerable ideas in connection with them, which cannot be treated individually in a short paper.

Owing to the immense production of incandescent lamps, the manufacture of evacuated bulbs has been so perfected and cheapened, that general current control with this system will probably be many per cent. cheaper than any method now in use.

There is a large variety of rheostats and current controllers on the market designed to be used medically, and since the interrupted current, owing to its peculiar effects on the human system, is now being used in medicine, no better form of current controller could be devised than by employing the principle under consideration, as more delicate currents can be supplied than by any other method or means, owing to the steady rate of vibration caused by the non-deoxidization of the contacts in the vacuum. This is clearly proven in that the pitch of the note produced by the vibrating armature is almost constant.

A varying-in-pressure contact could be used with advantage in connection with all delicate measuring instruments. It would materially aid in making them "dead beat," as it could then be made impossible to strain them by suddenly turning on and off the current.

HEDGEHOG TRANSFORMERS AND CONDENSERS.[1]

BY FREDERICK BEDELL, K. B. MILLER AND G. F. WAGNER.

THE authors devoted the first part to the description of apparatus and measurement. The method of instantaneous contact was employed for obtaining the E. M. F. at various points of the phase, for which purpose the contact employed consisted of a needle attached to a revolving disc which cut through a fine stream of water at every revolution, and the potential difference was obtained by means of a multicellular voltmeter with a pneumatic damping arrangement, devised by Prof. Ryan. The Hedgehog transformer primary consisted of 1,426 turns of wire, 0.072 inch in diameter, arranged in twelve layers. Its resistance was 2.748 ohms, and its weight 29 pounds. The secondary consisted of 78 turns of cable composed of nineteen strands of 0.058 inch wire, with a resistance of .0149 ohm, and weighing 12.5 pounds. The transformer was designed for 1,000 volts at 130 periods.

Experiments show that at no load the lag of the primary current behind the primary E. M. E. is almost 90 degrees, which is greatly in excess of the lag shown by similar experiments upon transformers with closed magnetic circuits. The secondary E. M. F. at no load is almost opposite in phase to the primary E. M. F., that is, almost 180 degrees behind it. With increased load the lag increased slightly, due to increased leakage. The curve for efficiency rises very rapidly as the load increases, reaching 90 degrees at about ¼ of full load. From quarter load it is nearly constant, rising to 96.6 per cent. at ⅜ load. It remains practically constant until full load is reached and then falls off slightly on overload. The all-day efficiency calculated on a basis of 5 hours at full load out of 24 hours is 91.8 per cent. There is a fall of about 2.5 volts in the secondary between no load and full load.

Tests were then made with Stanley condensers in circuit and readings taken for determining the primary E. M. F., secondary E. M. F., primary and line current. The results of three runs are given in the following table, showing clearly the effect of the condenser in diminishing the line current, especially at no load.

Lamps in Secondary.	Primary Current.	Line Current.
0.	.95	.187
15.	1 24	.867
45.	3.07	2.73

At no load the line current is seen to be less than one-fifth of the primary current, or the value it would have if the condensers were absent; even under full load the reduction is considerable. As the results of these tests the authors conclude the transformer upon which the investigation was made, possesses two valuable features, high efficiency and good regulation. The experiments with the condensers, demonstrate the practicability of their use to diminish the line current in transformer circuits, and points to their more extended use, as their manufacture is perfected and cheapened, not only in this, but also in other systems of alternating current distribution.

1. Abstract of a Paper read before the American Institute of Electrical Engineers, Oct. 18, 1893.

ELECTRICITY IN ADVERTISING.[1]

THE author began by saying that ten years ago the subject would have been considered as covering a very narrow field, but at the present time the very highest attainments in the field of advertising are achieved by various applications of electricity. There are various ways in which the current could be applied for this purpose and even though a man be blind he could still have his attention attracted electrically through his sense of hearing and feeling by aid of the electric shock, and the electric window tapper or whistle. It was by means of the electric light, however, that the greatest effects in this direction could be accomplished. The author then cited examples of various devices and arrangements involving the use of the electric light, such as the illuminated waterfall experiment, first shown by Trouvé, and lighting up the body of a live fish that had been made to swallow a miniature incandescent lamp. The most impressive feature at the World's Fair was the electrical display, in one sense a hugh advertisement, from the writing wand of the Western Electric Co. and the illuminated Ferris wheel to the beautiful electric fountains themselves and the search lights which were made to attract the attention of the public for a distance of sixty-five miles. Then, again, the employment of the search-light to project advertisements on the clouds was another development.

Perhaps the most generally applicable and flexible method of electrical advertising was that accomplished by means of incandescent lamps suitably grouped to form designs, words or sentences, and owing to the rapid extension of electric currents into almost all buildings it was now possible for tradesmen to install in their windows, at a small expense, a sign of this nature without the dangers which would ever be present with the application of gas for such purposes. The author stated that pioneer work in this direction had been done by Mr. Wm. J. Hammer, who in 1881 had designed and constructed what was probably the first electric sign in existence, outlining the name of Edison in incandescent lamps and placed over the organ of the large concert hall at the Crystal Palace Electrical Exhibition of 1882 in London. Mr. Hammer was also the pioneer in the art of using incandescent lamps to produce novel effects. The lecturer remarked that it was not generally known that a 1 c. p. lamp cost about the same as the ordinary 16 c. p., and the 8 c. p. lamp even more. When signs consisting of miniature lamps are rented a charge of 10 per cent. of their cost is made for a single night and 1 per cent. for each succeeding night, and a large variety of standard designs can now be obtained on demand. Kelway, in England, has devised a system for spelling out words letter by letter by means of incandescent lamps.

The immense electric sign at the south end of Madison Square was the most gigantic in the world, measuring 60 x 68 feet; it cost about $6,000 and consisted of 107 letters averaging 6 feet high. It is composed of 1,457 lamps, representing 145 h. p. The current for operating the sign is taken from the Edison Illuminating Company's mains and costs 24 cents a minute when the entire sign is illuminated. It was highly desirable, however, to be able to vary the sign and the words at will, and to effect this the author described a system of his own which consists in arranging lamps in cross section, that is, placing them at equal intervals in horizontal and vertical rows. A cable consisting of as many separate wires as there are lamps, connects them with a small table, which we will call the operating board. This operating board, placed at any suitable distance, is completely covered with push buttons, arranged closely together, so that each little push button on the small operating board will correspond to a lamp on the large surface used as a sign. By pressing on any single push button or circuit closer, a lamp similarly situated on the sign will be lighted. Simply writing or drawing on the face of the operating board, and thereby pressing on certain buttons, will cause corresponding lamps to light—all others remaining dark—and practically any effect desired can be produced on the sign on a greatly enlarged scale. With this method letters, sentences, designs, and what are termed chalk talks, are practicable. The lecturer illustrated his remarks by stereoptican views and prominent electrical displays. The electric lantern used on this occasion was the invention of Mr. Hopkins, a member of the Society, and operated admirably. It was loaned by Messrs. J. B. Colt & Co.

TELEPHONE NEWS FROM TROY, N. Y.

Crossed wires disabled the Messenger Service Department of the Telephone Co. a few days ago by a fire in the switchboard. Damage about $100.

The Telephone Company are now having a new switchboard for their operating room built in New York City, to cost in the neighborhood of $13,000, and intended for the accommodation of 1,200 subscribers. It is to be completed January 1, 1894, by which time it is expected that each subscriber will be placed on a metallic circuit.

1. Abstract of a Lecture delivered before the New York Electrical Society, Oct. 31, 1893.

STUDIES OF THE PHENOMENA OF SIMULTANEOUS CONTRAST-COLOR; AND A PHOTOMETER FOR MEASURING THE INTENSITES OF LIGHTS OF DIFFERENT COLORS.[1]—I.

BY ALFRED M. MAYER.

It is often desirable in the study of simultaneous contrast-colors to have large surfaces colored by contrast, so that we can the better match the colors of these surfaces with rotating colored discs and thus arrive at quantitative statements of their hues. This is especially desirable in ascertaining the hues of the light of flames, of the Welsbach incandescent lamp and of the arc electric light when compared with daylight, or, when compared one with another. The result of many experiments is the apparatus described in the following section and which is useful for this purpose.

Screen for ascertaining the hues of lights and the contrast-colors of these lights.—A ring is formed of white card-board by cutting out a central opening of 12 cms. in diameter in a disc of 22 cms. in diameter. This ring has a breadth of 5 cms. Another ring is made similar to this one, except that it has four narrow radial arms to support a disk of thin translucent *white* paper,[2] 35 cms. in diameter. This paper disc is placed between the rings, which are then fastened together and screwed to a thin rod, on a stand, as shown in Fig. 1.

Place the screen, thus formed, in front of a petroleum lamp and exclude the daylight from the side thus illuminated. The

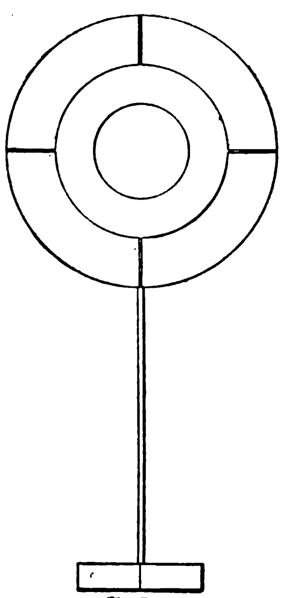


Fig. 1.

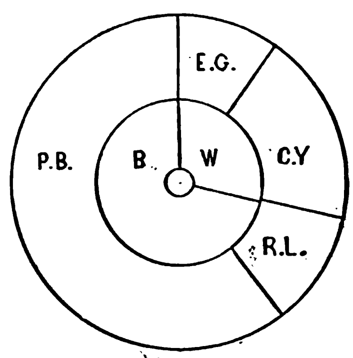


Fig. 2.

other side of the screen is illuminated by the light of the sky admitted through a distant window. The card-board ring is thus illuminated on one side only by the lamp; on the other side, only by the daylight. The translucent paper transmits the lamplight to the side facing the window, while it transmits the daylight to the side facing the lamp. On the side of the screen facing the window the card-board ring appears cyan-blue while on the side facing the lamp the ring appears orange yellow.

Hues of the sides of the ring.—An idea of the hues and intensities of these colors, which cause astonishment even in those who are experimenters in chromatics, will be given by the description of the following experiments.

By means of a Bunsen photometer disc I adjusted the distance of the lamp from the screen so that I obtained, as nearly as I could judge, equal illumination of the sides of the screen. I then found that the blue was matched in a rotator by a disc having a sector of 60 parts of the circumference of Prussian blue, with a sector of 10 parts of emerald green and a sector of 30 parts of white card-board. The blue was that of one of the many colored discs given me by Professor O. N. Rood and was marked, "Blue between cyan-blue and the ultramarine of the physicist, but nearer the latter. Near F and on its more refrangible side. Made with Prussian blue." The blue on this disc appeared as saturated in hue as could be made by the pigment

1. From the *American Journal of Science*, Vol. xlvi., July, 1893.

2. Trials with many kinds of paper showed that a white linen tracing paper was the best. It is not possible to describe this so that one may be sure of selecting a similar paper. It was obtained of Keuffel and Esser, Fulton street, N. Y., and sold as "No. 203 Alba tracing paper."

The match of the color of the side of the ring facing the lamp, L, in Fig. 3, was obtained by placing a silvered mirror, M, so that the reflection of this side of the ring, S, was seen close to the rotator R.

The color of the cardboard ring facing the lamp was matched by the rotation of a disc formed of 50 parts of chrome yellow, 30

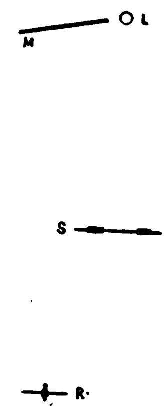


Fig. 3.

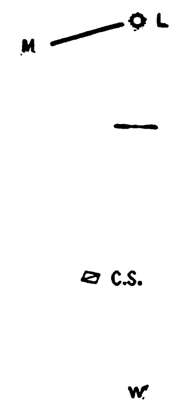


Fig. 4.

parts of red lead (red orange) and 20 parts of white card-board. Such appears to be the hue of the light of a petroleum flame when compared, in this manner, with the light of the sun.

The petroleum flame used in these experiments was that of a Belgian burner, giving about 35 candles. The daylight was obtained from a window 85 cms. square; the lower half of which when viewed from the screen, was occupied by the snow-clad surface of an opposite hill. The day was very clear, and the sky very slightly tinted with blue.

The colors of the sides of the ring of the screen are complementary.—I combined the Prussian blue, emerald green, chrome yellow and orange red on a disc on the rotator and found that when the disc was formed of sectors having 60 parts of Prussian blue, 11 of emerald green, 19 of chrome yellow and 10 of red lead, I obtained a gray which was exactly matched by a central disc formed of 71 parts of dead ivory black and 29 of white card-board; see Fig. 2. These measures gave the following equation:

$$\left\{\begin{matrix}\text{60 Prussian blue}\\ \text{11 Emerald green}\end{matrix}\right\} + \left\{\begin{matrix}\text{19 Chrome yellow}\\ \text{10 Red lead}\end{matrix}\right\} = \text{Gray}\left\{\begin{matrix}\text{71 Black}\\ \text{29 White}\end{matrix}\right\}$$

It is rather difficult to get the exact match on the rotating disc of the hues on the front and back of the card-board ring of the screen on account of the illumination of these surfaces. The rotator must be placed nearer the window than the screen so that it is well illuminated.

The equation shows that the cyan-blue of 60 parts of Prussian blue + 11 of emerald green is complementary to an orange yellow of 19 of chrome yellow + 10 of red lead. The hue of this orange of the lamp side of the ring, as given by the rotator, was 50 chrome yellow + 30 red lead + 20 white, which mixture is approximately in the proportion of 19 to 10. The correspondence of the two experiments is, I suppose, about as near as could be expected from the difficulty of matching the illuminated hues of the ring of the screen.

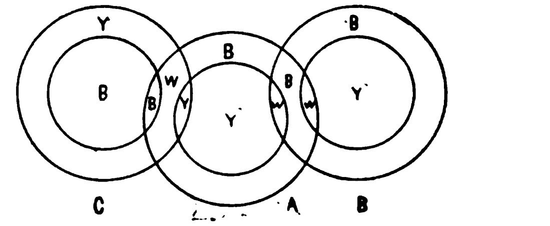


Fig. 5.

The small central disc on the rotator gave a gray of 71 parts of ivory-black + 29 of white card-board, which matched the gray given by 71 parts of cyan-blue + 29 parts of orange. Calling the intensity of the orange 100, we have 100 — 29 = 71 I, which gives for I (the intensity of the cyan-blue), only 40.8 per cent. of that of the orange.

The orange yellow of the side of the ring facing the lamp and of the side of the translucent paper facing the daylight is comple-

mentary to the cyan-blue of the side of the ring facing the daylight and of the side of the translucent paper facing the lamp.

In Fig. 4, L is the lamp; S, the screen which in this experiment is deprived of the border of translucent paper; W, the window; M, a silvered mirror which reflects the back of the screen to the eye which looks through an achromatized double refracting calc-spar prism at C S, and sees two images of the side of the screen reflected from the mirror and two images of the side of the screen facing the window. By suitably inclining and rotating the calc spar prism these images may be brought into the positions shown in Fig. 5, in which A represents one of the images of the side of the screen facing the window; B, the other image of the same; C, is one of the images of the side of the screen facing the lamp and seen by reflection from the mirror.

The overlapping of these images, when the illumination is properly adjusted, gives the following results, as shown by the letters in Fig. 5, where B stands for cyan-blue, Y for orange yellow, and W for white. The translucent paper Y, of B, overlaps the ring of A and gives white, and the blue of the ring of B overlaps Y of the translucent paper of A and gives white. In the same manner the orange yellow of the card-board ring of C overlaps the blue of the ring of A and gives white. Where the ring of C overlaps the translucent paper of A there is a more intense orange, and where the blue of the translucent paper of C overlaps the blue of the ring of A we have a more intense blue. On bringing B of the translucent paper of C over Y of the translucent paper of A we have white.

Experiments on the complementary colors of gratings.—Out of thin card-board, such as is used for thin visiting cards, I cut

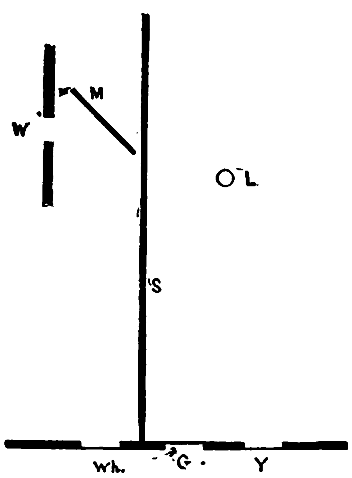


FIG. 6.

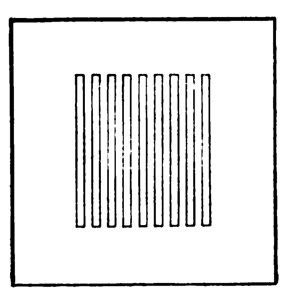


FIG. 7.

gratings with a dividing engine. See Fig. 6. The widths of the spaces cut out of these gratings exactly equaled the breadths of the cradboard left in the grating. Gratings were thus made having spaces of 1, 2, 3, 4 and 5 mm. The card-board is rendered opaque by coating one side of it with ivory-black in dilute shellac varnish. After it has dried the cardboard is well-flattened before it is fastened to the surface of a piece of hard wood on the dividing-engine. The cutting edge of the cutter for this work must have a very acute angle. I made one by grinding down a rod of Stubs' steel. Heating this to a dull cherry red and then forcing it into a large ball of beeswax gives the edge of the cutter the required temper, without the necessity of subsequently "letting it down." The blackened side of the gratings was covered with the "Alba tracing paper." The grating was mounted back of an opening in a black card-board screen, so that only the white grating was exposed. The other black screens, wh and Y of Fig. 7, having openings of the same size as the grating and covered on the back with the translucent paper, were placed on either side of the grating, G. In Fig. 7, L is the lamp. The window is on the other side of G. The screen S divides the apparatus so that the light of the window W reflected by the mirror M on to the screen *wh* cannot fall on G or on Y, which are only illuminated by the lamp L.

The translucent paper of the grating G and of the screen Y appear orange yellow. The bands of white card-board of the grating appear cyan-blue. The translucent paper of the screen *wh* is white.

Sit a little to one side of the grating so as not to intercept the light from the window, and look at the grating through the calc-spar prism. Rotate it till the blue bands of the grating are superposed on the orange bands, when, if the surface of the grating is equally spaced, the superposed surfaces appear white when compared with the white of the screen *wh*. Without the screen *wh* the eye has no term of comparison and may take a yellowish white for white. The illumination of the screen *wh* should be made equal that of the superposed images of the grating.

When this experiment is carefully made, with the proper illumination, the effect is surprising when, in favorable conditions, on rotating the prism you see the grating actually obliterated with no bands visible, but only a uniform white surface. The grating with spaces of 3 mm. gave the best results.

In experiments with the screen, Fig. 1, formed of the card-board ring and the translucent disc, it is easy, by altering the relative intensities of the daylight and lamplight and by changing the distance of the lamp from the screen, to produce great changes in the saturation of the contrast-colors. Indeed I have sometimes thus obtained, towards nightfall, a cyan-blue so saturated in hue that little or no white was required in the disc of the rotator to match the color on the ring. In the same manner similar changes in color have been observed in the hue of the ring illuminated by the lamp.

On illuminating one side of the screen by daylight and the other by the white light of a Welsbach incandescent lamp, and then placing colored glasses or films of colored gelatine between the screen and the Welsbach lamp effects of contrast are obtained which are so readily imagined by the physicist as to require no description; but they are worth viewing.

GOVERNMENT TELEGRAPHS.

IN the United States Senate a bill has been introduced by Senator Butler having for its object the establishment of a Government system of telegraph lines. The bill directs the organization of a board to consist of the Secretary of State, the Secretary of War, and the Postmaster-General, who are directed to arrange a system of trunk line telegraphs connecting the various sections of the country with the city of Washington, with connections along these lines to such cities as shall best subserve the public good. This system is to be carried on as a part of the postal system of the country, and discrimination in rates is prohibited, except that a lower rate is allowed for press messages than for current business. The carrying on of the telegraph business by individuals or corporations is not prohibited. An appropriation of $5,000,000 is made to begin the work.

THE LAUNCHING OF THE "OREGON."

ON the occasion of the launching of the U. S. man-of-war *Oregon* three young ladies officiated at the ceremonies. They stood upon the platform at the bow of the Oregon as she lay on the ways at the Union Iron Works. In front of each was a hand-painted panel, 12 x 16 inches, on which was lettered: "U. S. battleship Oregon, Oct. 26, 1893, 11.46 a. m." In the lower left hand corner of the panel was an electric button. Right opposite the bow and straight in front of the torpedo tube was a third panel resting on a table on the same platform. When the word was given by the superintendent of the iron works, the three young ladies simultaneously touched the electric buttons on the panel before them.

The launching button set free the heavy weight on a 25-foot guillotine, which in falling cut the heavy cord on the block below and set free the wedges, that keep the vessel from sliding off the ways at the last moment. The electric apparatus set in motion by the two young ladies at either end of the platform allowed two bottles of champagne, gaily decorated with red, white and blue ribbons, to drop against the bow. Both exclaimed as they touched the buttons, "We christen thee Oregon."

OBITUARY.

DR. WM. F. HUTCHINSON died suddenly in Providence, R. I., on Sept. 30, in consequence of organic disease of the heart. Dr. Hutchinson who was 55 years old, was well-known as a leading physician in Rhode Island and as a specialist in electricity. He was a veteran of the army and the navy, was several times wounded and was confined in Libby Prison whence he escaped. After his honorable discharge as brigade surgeon he entered the Navy as past assistant surgeon and was in several naval battles. After the war he practiced a few years in Minneapolis and then went to Providence where he continued to practice until his death. He was a freemason of the 33d degree, and founded the Arnold Post G. A. R. of which he was commander several times. He was an able writer, and besides contributing many articles on electro-medical subjects to the medical journals was also the author of "Practical Therapeutics"; he also wrote several novels. To Dr. Hutchinson is also due the discovery of the anæsthetic effect of the Faradic current when the number of interruptions of the Faradic coil correspond to the pitch of the tuning fork C. Dr. Hutchinson was a most entertaining and jovial companion and enjoyed the esteem and confidence of a wide circle of friends who mourn his loss.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 24, 1893.

Accumulators :—

Storage Battery, C. W. Kennedy, Philadelphia, Pa., 507,139. Filed Oct. 19, 1892.

Employs an active section consisting of a frame of non-conducting acid-proof material and containing a plate of metallic lead coated on one side with red lead and on the other with litharge.

Secondary Battery, C. A. Smyth, Momence, Ill., 507,463. Filed March 8, 1893.

The electrode is produced by oxidizing perforated leaden blocks in a bath of nitric acid and water, producing a plastic active material, moulding the active material and perforated blocks and subjecting them to pressure to unite the whole into a solid homogeneous body.

Alarms and Signals :—

Electric Signal for Railways, A. B. Herrick, Bayonne, N. J., 507,125. Filed Feb. 11, 1891.

An Electric block signal system for steam railways in which the signal is given in the locomotive cab.

Electric Alarm Signal for Railway Trains J. M. Rupel, Kansas City, Mo., 507,170. Filed April 26, 1892.

An electric apparatus for notifying the train men of the breaking of a draft coupling.

Electric Fire and Stable Alarm and Horse Releaser, A. R. Holmes, New York, N. Y., 507,322. Filed Feb. 4, 1893.

Electric Apparatus for Controlling Signals, M. B. Leonard, Richmond, Va., 507,518. Filed March 14, 1892.

Conductors, Conduits and Insulators :—

Insulated Wire, H. H. Brown, Montreal, Can., 507,257. Filed Oct. 12, 1892.

Employs an inner waterproofing coat of plastic substance, two braid coverings, the inner one of which is saturated with a solution of silicate of soda, and an outer coating of size.

Connector, C. Bell, Stroudsburg, Pa., 507,403. Filed Jan. 28, 1893.

Consists of two similar longitudinally grooved parts and a clamping screw passing through one part into a threaded hole in the other.

Distribution :—

Apparatus for Controlling the Application of Electrical Currents, R. Lundell, Brooklyn, N. Y., 507,144. Filed April 4, 1893.

The method consists in first interrupting the circuit, then effecting the desired change in the circuit relations of the field and armature coils, and afterwards re-establishing the circuit.

Device for Selecting Mechanical Apparatus, R. Mackie, Cincinnati, O., 507,147. Filed July 14, 1891.

Employs two sets of electromagnets with their armature levers and means for shunting the current from one set to the other to return the combination sector to its starting point.

Apparatus for Selecting and Operating Mechanical Devices, R. Mackie, Cincinnati, O., 507,148. Filed July 14, 1891.

Employs a mechanical apparatus advanced into position by impulses from an electrical transmitting instrument, and a selecting instrument responding to a predetermined arrangement connecting the transmitting instrument with the mechanical apparatus.

Electric Selecting Device, S. S. Bogart, New York, N. Y., 507,205. Filed Nov. 24, 1891.

Employs a movable wheel with a mechanical representation of a fixed combination of electrical impulses and an electromagnet whose armature lever acts directly upon the wheel and responds to the transmitted impulses to impel the wheel to work out the combination.

Electric Selecting Device, S. S. Bogart, New York, N. Y., 507,206. Filed Dec. 9, 1891.

Similar in its object to 507,205.

System of Electrical Distribution, W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass., 507,391. Filed March 8, 1892.

Provides a self-regulating converter system in which the primaries of the induction devices are connected in series with the inducing circuit and the translating devices in multiple with the secondaries by which they are supplied with current.

Distributing Frame for Electric Wires, W. S. Ford, Chelsea, Mass., and B. A. Lenfest, Wakefield, Mass., 507,434. Filed March 31, 1892.

Dynamos and Motors :—

Armature for Dynamos, J. J. Wood, Fort Wayne, Ind., 507,194. Filed June 8, 1893.

Employs an armature core in the form of a laminated ring having polar projections for receiving the coils constructed with ventilated channels extending outwardly along the polar projections.

Armature Coils for Dynamos, G. Wilkes, Detroit, Mich., 507,297. Filed June 20, 1893.

A form of armature winding, the coils of which are wholly completed before being applied to the core.

Commutator Brush Holder, J. J. Wood, Fort Wayne, Ind., 507,344. Filed June 27, 1893.

Reciprocating Electric Motor, H. Pieper, Fils, Liege, Belgium, 507,449. Filed Sept. 23, 1891.

Heating :—

Electric Heater, C. L. Coombs, Washington, D. C., 507,217. Filed Feb. 11, 1893.

Employs insulated carbons between suitable heads and connected in series, together with the switch lever for bringing one or more resistances into the circuit.

Lamps and Appurtenances :—

Hanger Board for Electric Arc Lamps, J. J. Wood, Fort Wayne, Ind., 507,343. Filed June 7, 1893.

Metal Working :—

Electric Heating and Welding Apparatus, C. L. Coffin, Detroit, Mich., 507,419. Filed Jan. 26, 1893.

Relates to electric welding by means of an arc established between the metal to be welded and the extraneous conductor.

Hanger for Electric Lamps, G. P. Hiller, Grand Haven, Mich., 507,364. Filed Dec. 3, 1892.

Employs a runway on which rolls a two wheeled trolley supporting the lamp for the purpose of readily moving the ladder from one point to another without breaking the connection.

Metallurgy :—

Electrolytic Production of Metals, C. Hoepfner, Berlin, Germany, 507,130. Filed July 16, 1888.

Relates especially to the extraction of copper or silver free from other metals usually found in their ores.

Miscellaneous :—

Electric Door Operating Apparatus, O. H. Hicks and R. F. Troy, Chicago, Ill., 507,269. Filed May 15, 1893.

An electrical apparatus for automatically opening and closing doors (see THE ELECTRICAL ENGINEER, Sept. 20, 1893).

Application of Electricity to Pianos or Other Keyed Instruments for Hygienic Purposes, W. Willeringhaus, London, Eng., 507,298. Filed May 29, 1893.

Resistance-Coil, J. J. Wood, Fort Wayne, Ind., 507,345. Filed June 30, 1893.

Consists of two parallel metal tapes one wound with an open spiral of insulating material and the two coiled together in a flat coil.

Adjustable Induction Coil, E. M. Senseney, St. Louis, Mo., 507,458. Filed Dec. 5, 1892.

Electrode, F. M. Lyte, London, Eng., 507,374. Filed July 1, 1893.

A hollow carbon electrode closed at the bottom and having a core of metal or alloy fusible at or below the temperature at which the electrolytic decomposition of a fused metallic salt is to be performed.

Railways and Appliances :—

Trolley Wire Cleaner, C. H. Thompson, Detroit, Mich, 507,247. Filed Dec. 19, 1892.

Employs a spring arm carried by the car or trolley pole and electric means for compelling the arm to strike the wire repeatedly.

Trolley Wire Insulator, M. S. Williams, Syracuse, N. Y., 507,299. Filed July 5, 1892.

Closed Conduit Electric Railway, R. Weir, Montclair, N. J., 507,339. Filed May 10, 1893.

Employs two flexible flaps one enclosing the conductors and the other covering the slot of the conduit, in combination with a collecting device carrying two cams, one to uncover the conductors and the other to uncover the slot.

Electric Locomotive, J. T. Wilson, Tyrone, Pa., 507,396. Filed April 7, 1893.

Employs two motors coupled by a connecting rod and communicating power to the wheels reciprocally after the manner of a steam engine.

Conduit for Electric Railways, G. F. Green, Kalamazoo, Mich., 507,498. Filed April 28, 1892.

A sectional conduit whose parts may be readily separated for examination or repair.

Switches and Cut-Outs :—

Cut-Out, L. W. Miller, Rochester, N. Y., 507,150. Filed July 29, 1893.

Designed especially for use with fire alarm or police signal boxes.

LEGAL NOTES.

LIABILITY OF ELECTRICAL CONTRACTORS IN CASE OF FIRE.

A LEGAL battle of unusual interest to the electrical fraternity has just been decided by the U. S. Circuit Court, at Hartford.

Messrs. H. Ward Leonard & Co. wired a theatre at Middletown, Conn., for the Middlesex Mutual Insurance Company who owned the building. The wiring was connected with the local central station. On the Sunday evening after the work was completed, and before it had been fully paid for, a fire broke out in the building and did damage to the extent of some $40,000. The property was insured, and in paying the loss the various insurance companies, six in number, took subrogation contracts enabling them to sue any party they might consider responsible for the fire.

H. Ward Leonard & Co., after repeated demands for the money due them, finally brought suit for the balance due, some $8,800. This was met by a cross bill from the insurance companies, suing H. Ward Leonard & Co. for $40,000 damages, claiming that they caused the fire by negligence and improper construction. H. Ward Leonard & Co., feeling confident of their position pressed their suit and after various delays the case was heard before Judge Townsend last week. The result was a complete vindication for the firm who recovered the full amount of their claim with interest and costs.

John S. Wise represented H. Ward Leonard & Co., with Briscoe & Andrews, of Hartford, associated with him. On the insurance companies' side the best legal talent in Connecticut were arrayed, including Messrs. Robinson, Chamberlain, White, Mills and others. The insurance people made a strong fight with the object of establishing a test case in their favor, and it is extremely fortunate for the electrical interests generally, that the work of the contractor in this case, nine-tenths of which was not affected by the fire, was proved to be entirely free from defects so that the insurance interests were unable to establish their claim, or to in any way offset the full claim of the contractor.

ELECTRICITY DIRECT FROM THE SUN'S RAYS.

A CORRESPONDENT, who is well known to many of our readers, but who wishes his name withheld for the present, informs us that he has succeeded in obtaining a thermo-electric combination of metals which enables him to obtain effects far in excess of anything ever before obtained in this direction. The combination consists of six different metals thoroughly insulated and joined together to form one element. Two such elements measuring 6 x 3 x 4 inches, it is claimed, are capable of developing an E. M. F. of 110 volts after five minutes' exposure to the sun's rays. According to the statements of the inventor, the method is universally applicable and will go far towards supplanting the dynamo, as the surplus electrical energy can be stored, to be given out again during the hours when the sun is not shining. We are informed that patents have been allowed on the new element by the United States Patent Office.

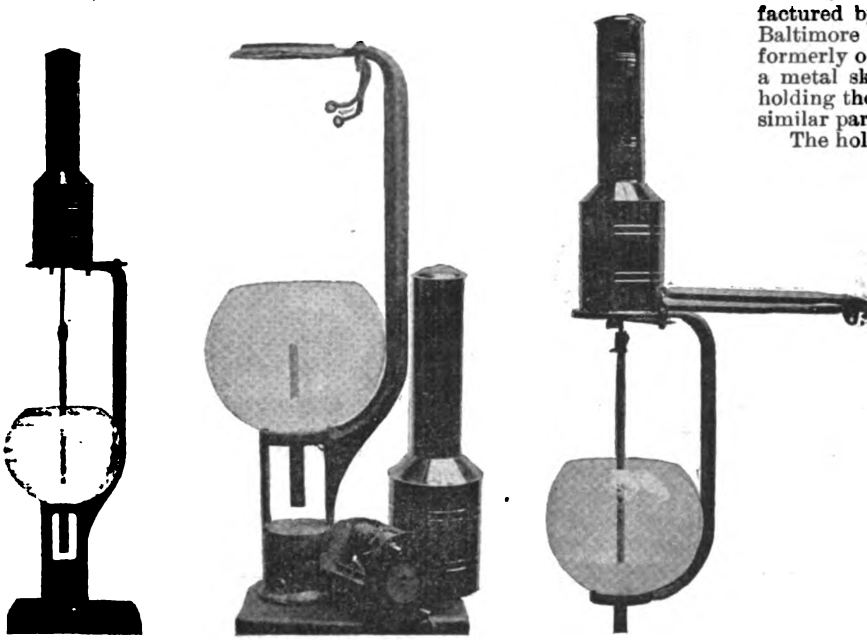
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE COWLING "UNIVERSAL" LAMP AND BRACKET.

In spite of all precautions arc lamps will get out of order, and ordinarily, when it is necessary to replace one pole top lamp by another, considerable labor attends the change, and the services of two men are required, together with a horse and wagon. It is interesting, therefore, to note the arrangement recently devised by the Powellton Electric Co., of 108 South 40th street, Philadelphia, and shown in the accompanying illustrations. In the "Universal" lamp, one man or boy can make the change in five minutes, by simply loosening three thumb screws, removing the defective clock work, or clutch mechanism, and substituting the repaired one. The thumb screws are used for holding the mechanism in position, and, passing through washers on the line terminals, are also used to connect the latter with the working parts of the lamp.

The bracket, as shown in Figs. 1 and 2, can be used in connection with clock work or clutch mechanism of any system, for either single or double lamps, using either 12 inch or 14 inch carbons. The bracket forms the bottom part of the lamp, and acts as a support either in the case of pole top or swinging lamps, and renders unnecessary any additional fixtures.



Figs. 1, 2 and 3.—The Cowling "Universal" Lamp and Bracket.

The fitters are so arranged that the bracket can be changed to suit either single or double lamps in a few minutes, and the hood, while easily removed, is absolutely dust and rain proof, fully protecting the working parts of the lamp.

By this arrangement the shadows are reduced one-half, and the first cost and maintenance are reduced by reason of the simplicity and reliability of the lamp, and the inexpensive method of changing when necessary to bring lamps in for repairs.

Fig. 3 shows a side suspension of the bracket.

THE MORSE, WILLIAMS & CO. ELEVATOR.

The direct electric elevator, built by Messrs. Morse, Williams & Co., whose main office and works are at Frankfort avenue, Wildey and Schackamaxon streets, Philadelphia, has been designed especially with a view of obtaining simplicity of construction, accessibility of parts for repair and smoothness in running, the latter exceedingly important feature being attained by the use of the improved Hindley worm gearing. The machine has a worm of bronze or steel and a wheel encased in an oil-tight housing and the thrust of the worm-shaft is taken on hard metal buttons revolving in oil.

The motor is attached to the worm-shaft by means of a coupling. The worm-shaft is provided with a powerful double shoe brake, which is released by the action of an electromagnet and is applied by a weight. The special advantage of this arrangement is shown in case the current from any cause be cut off, as the brake would be instantly applied, thus stopping the machine. The brake is so constructed as to act as a governor in checking the descent of the car, should it be accelerated beyond the normal speed at which the motor is designed to run it.

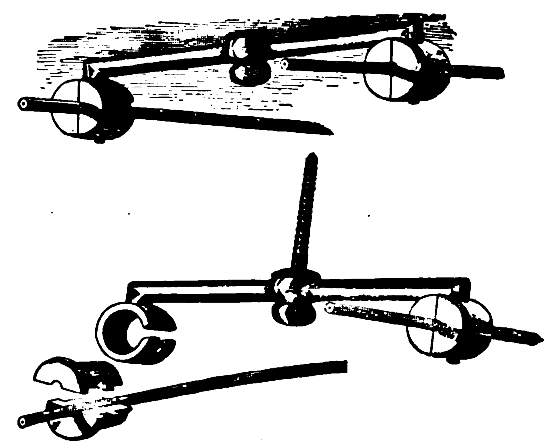
The drum upon which the cables wind is grooved in the lathe and keyed fast to the heavy shaft, to which the worm-wheel is also keyed. This shaft is provided with stop-collars and nuts, arranged to stop the car at terminal landings independently of the operator. The slack cable stop arrangement is also a feature of this elevator; it stops the machine automatically in case the car should become obstructed in its descent and stop. Without such an attachment there would be an unwinding and consequent entanglement of the cables with the machinery. The motor is of the low speed, multipolar type, the bearings are self-oiling and carbon brushes are used, requiring a minimum of attention. The reversing switches and controlling apparatus are of simple and improved forms, their action causing the elevator to start easily and gently with and without a load.

The whole apparatus is placed on a heavy cast-iron bed-plate and the motor is thoroughly insulated therefrom when a high-tension current is used to obviate danger of shock in the car. The efficiency of the machines has been tested under varying conditions, and the average amount of current consumed, both in raising the load and lowering the empty car, has been found to be extremely low. These machines are designed to raise average loads at speeds as high as 250 feet per minute.

THE TRIMBLE INSULATOR.

This neat and simple insulator which is now being manufactured by the Trimble Patent Insulator Company, of 311 West Baltimore street, Baltimore, is the invention of W. D. Trimble, formerly of the Wenstrom Company, of Baltimore. It consists of a metal skeleton with holders and slots in the ends designed for holding the insulators proper, which are made of porcelain in two similar parts with a boss on each half.

The holder or skeleton has a stationery screw in the centre for fixing to the ceiling or wall. To adjust the insulator one simply presses the screw into the ceiling using the holder as a lever. The two halves of the insulating block are then placed around the wire, slipped into place in the holder and given a half turn to secure them against displacement. No tie wires are, therefore, necessary. The device will be readily understood by reference to the accompanying illustration.



The Trimble Insulator.

QUEEN & COMPANY, INCORPORATED.

Queen & Company, Incorporated, Philadelphia, express themselves as exceedingly pleased with the large orders obtained as a result of their extensive World's Fair exhibits. In addition to commercial instruments, they find a steadily increasing demand for the standard electrical apparatus which they manufacture with the greatest precision, and a number of the principal colleges have purchased extensively for laboratory equipments.

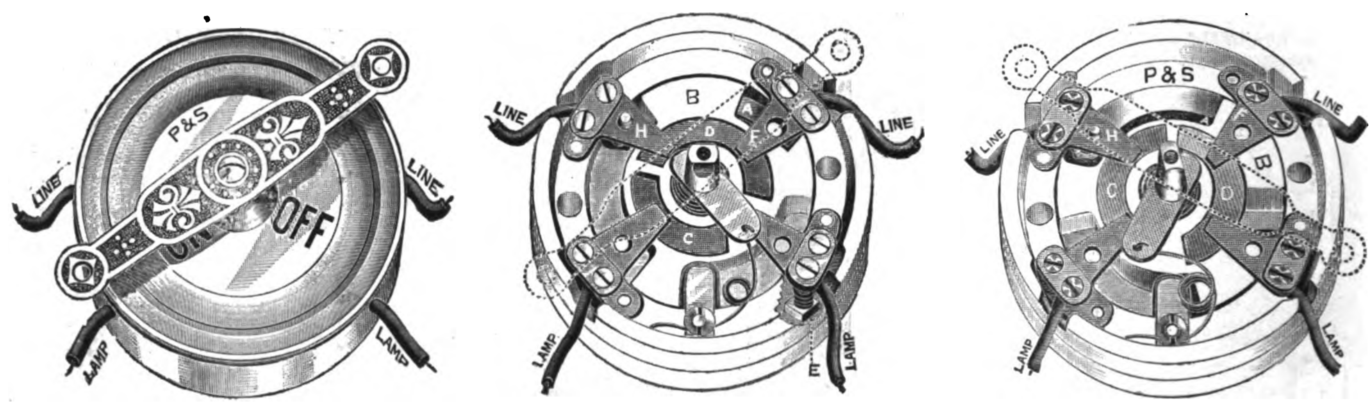
Among these may be mentioned: Armour Institute, Chicago; University of Chicago, Chicago; Case School of Applied Science, Cleveland; Mass. Institute of Technology, Boston; University of Iowa, Iowa City; University of Minnesota, Minneapolis; Alabama A. & M. College, Auburn; Colgate University, Hamilton, N. Y.; Rensselaer Polytechnic Institute, Troy, N. Y.; Adelbert College, Cleveland; University of Wisconsin, Madison; Western University of Pennsylvania, Allegheny; University of Tennessee, Knoxville; University of Nebraska, Lincoln; Northwestern University, Evanston, Ill.; University of Notre Dame, Indiana; University of Illinois, Champaign, etc.

THE "P. & S." ALL-CHINA ARC CUT-OUT.

THE accompanying illustrations show a novelty in arc cut-outs made by Messrs. Pass & Seymour, of Syracuse, N. Y. Fig. 1 shows the apparatus complete. The case, cover and circuit breaking cam, are all made of china, which removes the liability of grounding the circuit in wet weather, and gives an insulation impossible in cut-outs with metallic cases. It is ornamental and only 7 inches in diameter. The handle is nickelplated and can be operated by cords without the use of pulleys; or a pole or hook can be used, if desirable.

Fig. 2 shows the lamp circuit off. The line circuit is made through the contacts F and H and the plate D, and also through the lever A. By turning the handle, the china cam B is turned to the right, carrying the plates D and C with it, and passing between the contact F and the lever A, breaking the line circuit and throwing in the lamp circuit as shown in Fig. 3.

There can be no arcing on plates C or D when the line circuit is broken, as D leaves H before B opens the circuit, by passing between F and A. The cam B is moved very quickly by means of the torsion spring on the handle post, and as it passes between A and F the arc is pushed out, as well as blown out, by the puff of air produced by the sudden motion of B. The plates C and D are



FIGS. 1, 2 AND 3.—"P. & S. ALL-CHINA ARC CUT-OUT.

held against the contacts by three spiral springs under each, and a perfect rubbing contact is made. The clamps for the line wires have two heavy screws in each, and also nut and spiral spring as shown at E, Fig. 2, which insures a good contact at the connection.

THE CONSOLIDATED CAR HEATING CO.

A SPECIAL meeting of the directors of the Consolidated Car-Heating Company of Albany, N. Y., was held on Tuesday, October 31st and the final papers were signed transferring to an English syndicate the English steam and hot water heating patents of the Consolidated Car Heating Co. The English electric heating patents have not yet been taken by the syndicate, although it has an option thereon until January 1, 1894. The option of the heating patents which it bought would have expired November 1.

The total sales of the Consolidated Car Heating Co., including October, are slightly in excess of the sales at the same period last year. Within the last week orders for electric heaters have been received from 21 additional roads, making a total of 51 street railways in the United States and Canada which are using, or are about to use, the Consolidated Company's electric heaters.

The electric heating of trolley street cars has become an important branch of the business of the Consolidated Car-Heating Company, of Albany. Such electric heaters with regulating switch have been applied already to cars in 29 cities and towns throughout the United States and Canada. Among these cities and towns are: New York, Rochester, Albany, Elmira, Yonkers, Hudson, Jamestown, Rondout, Chicago, North Abington, Brockton, New Haven, South Norwalk, Newark, Philadelphia, Allentown, Akron, Piqua, Dayton, Omaha and Montreal, Toronto, Hamilton and Niagara Falls in Canada.

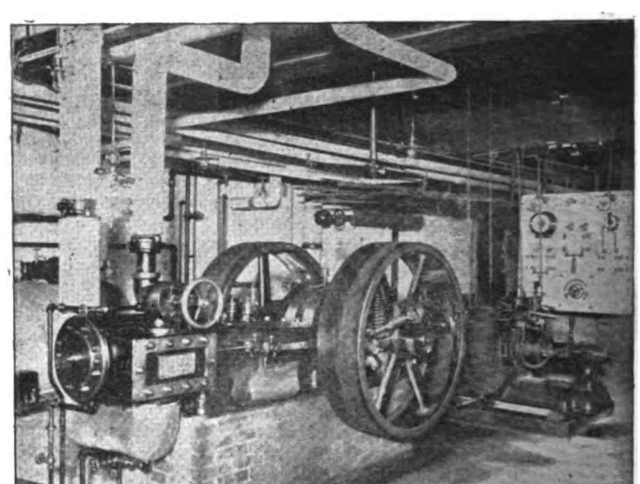
From the Rochester Railway the company has recently received a second order, from the Union Railway, New York, a third order, and from the Albany Railway a fourth order for such equipments. The Union Railway, New York City, and the Albany Railway have all their cars now equipped with the Consolidated Company's electric heaters and regulating switch.

SEVEN separate awards have been granted to Queen & Company in the Department of Electricity, which is evidence that the high quality of their product was appreciated by the Board of Judges.

AN ISOLATED PLANT FOR LIGHT AND POWER.

THE operating of lighting and power circuits from the same dynamo has only recently been introduced to a large extent and is due to the use of close regulating compound dynamos in isolated plants. An interesting plant of this character has been installed by the C. & C. Electric Co. for Messrs. Tarrant & Co. and is located in the new building on the corner of Warren & Greenwich streets, New York. A 25 k. w. 110 volt standard C. & C. dynamo driven by a Ball engine is located in the basement and the transmission of power from the engine to the dynamo is effected by the "L. P. D." system. This device economizes space greatly and has been found to work satisfactorily. The dynamo is compounded for a 3 per cent. rise in voltage at load. Near the dynamo is mounted a marble switchboard having the usual instruments and switches. The building is wired with two circuits, for power and light respectively, controlled independently by double pole switches on the engine room switchboard. On the lighting circuit there are three hundred 16 c. p. lamps distributed over the seven floors of the building. On the power circuit there is a one h. p. C. & C. motor in the basement operating bottling machinery, a 7½ h. p. C. & C. motor on the fifth floor running an elevator, and on the seventh floor are two C. & C. motors of 12 h. p. and 3 h. p. respectively, running machinery for grinding and mixing drugs and chemicals.

This makes in all a total motor capacity of 23.5 h. p. on the 25 k. w. dynamo in addition to the lamp load. There is no variation in voltage that can be detected on the lighting circuit and the lights are therefore as steady as they would be on a separate



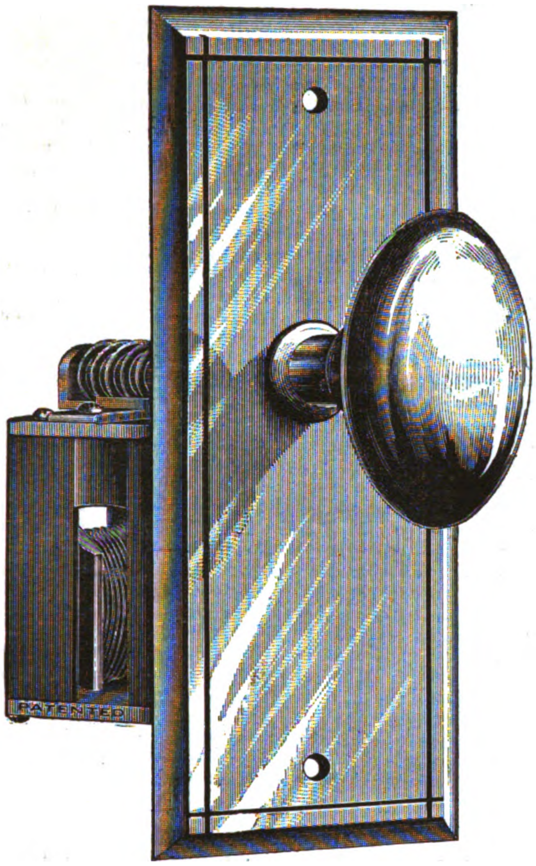
C. & C. LIGHTING AND POWER PLANT.

dynamo. This plant has now been in operation for several months. Credit is due to the engineer, Thos. E. Meyers, for the excellent manner in which it has been cared for and run.

THE new meter house for the East River Gas Company will be entirely of iron and brick. The roof trusses will be of iron covered with corrugated iron and glass, and are designed and built by the Berlin Iron Bridge Company of East Berlin, Conn.

THE "ARMATURE" BELL.

THE accompanying illustration shows a straight electric door-bell pull, made by the Armature Bell Company, of 216 High st., Newark, N. J. As will be seen, the mechanism consists of a small magneto enclosed in the mortise and operated by the pulling



THE "ARMATURE" DOOR BELL PULL.

of the handle to generate sufficient current to ring the bell, thus dispensing altogether with the use of a battery.

The same idea is carried out by the company in several other ways, such as lever pull bells for doors, and key-operated annunciator systems. In the latter a half turn of the key either to the right or left is sufficient. The armature occupies a space about $1\frac{5}{8}$ inches in diameter and about $1\frac{3}{4}$ inches in depth, and can, of course, be attached to wiring now in use. In the mechanical construction of the armature bells the best material has been used in order to combine durability with efficiency in the highest degree.

THE DETROIT BOAT WORKS.

THE DETROIT BOAT WORKS who built many of the electric launches used at the World's Fair have issued a neat little folder describing and illustrating their launches. The boats are very well built have graceful lines and are equipped with electrical apparatus of the most approved pattern.

WESTERN NOTE.

SARGENT & LUNDY, electrical engineers, contractors, etc., Monadnock Building, Chicago, have taken the western agency for the Crocker-Wheeler motors, generators, motor-tools, etc. The high standing and wide connections of the firm are such as to give immediate value and prominence to anything they may handle, while the reputation of the Crocker-Wheeler apparatus throughout the country has been gained by the best engineering construction, the most durable material and the finest workmanship. The new "combination" augurs well for the increase of popularity and sales of Crocker-Wheeler product in the great West.

THE LA ROCHE ELECTRIC WORKS have just received a large installment of machinery and tools from the Garvin Machine Co., of New York, and presses from the Ferracute Machine Co. of Bridgeton, N. J.

BABCOCK & WILCOX BOILERS AT THE WORLD'S FAIR.

IN explanation of the reasons why the Babcock & Wilcox boilers received no award at the World's Fair, we give below a copy of the "special notice" placed on the front of these boilers during the last few weeks of the Fair. The notice, we think, covers the ground fully, and the non-award of a premium to the Babcock & Wilcox boilers is simply due to the fact that the company preferred to remain *hors concours* under the circumstances.

SPECIAL NOTICE.

These boilers have received no Award.

Why? Read! Learn!

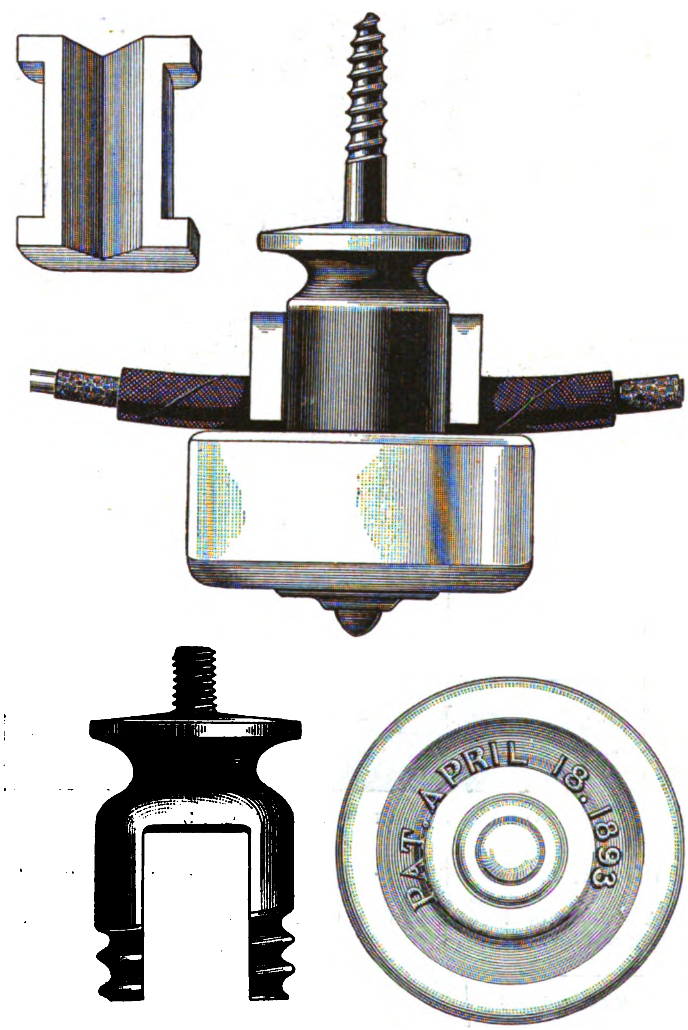
"We were informed that it was the purpose of the Jury to make awards on boilers based entirely upon the written statements of the exhibitors of boilers, without tests or any personal knowledge in the possession of said Jury concerning the comparative construction, operation, economy, or durability of said boilers. We were asked to make such a statement, and were informed that all other exhibitors of boilers had been requested to make a like statement of their claims for the consideration of the Jury of Awards.

"Believing that an award, based on such insufficient knowledge on the part of said Jury, could be of no practical value, and notwithstanding the expense incurred by this company in making an exhibit, we respectfully declined to make any such written statement for the purpose of receiving an award upon our boilers.

"While we do not in the least envy those who have, upon such knowledge by the Jury, been awarded premiums, we are equally content to stand upon the record without an award based on such a knowledge of our goods."

THE "SAFETY" INSULATOR.

THE accompanying illustrations show an insulator recently introduced by McLeod, Ward & Co. of 91 Liberty street, this city. Its use and operation are so clearly indicated that little remains to be said in the way of description. The insulating parts are made of porcelain and there is a slight raise on the upper piece, so that



THE "SAFETY" INSULATOR.

when the lower piece is screwed up the wire is clamped firmly, and bent slightly and cannot be pulled in either direction. It can be put up very readily without the use of a screw driver or other tool.

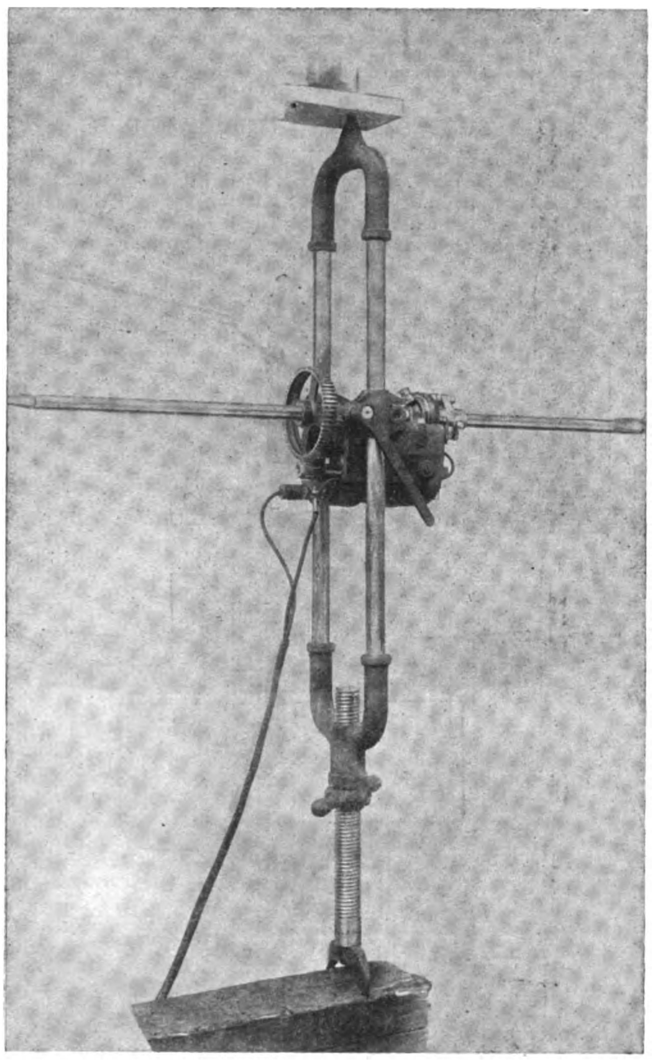
These insulators are made in a variety of sizes and are also furnished with machine screws, instead of the wood screw shown, if desired.

GENERAL ELECTRIC ROTARY COAL DRILL.

A small portable drill for both anthracite and bituminous mines to supplant the laborious breast drill, and to be used in place of percussion hand drills in work involving the removal of the slate or rock roof and floor has been recently put out by the General Electric Company.

Two types are made, one for heavy work in anthracite or drilling in hard slate or "boney"; the other for lighter anthracite drilling and for bituminous coal. The drills are interchangeable in their mountings, the same post taking any size. The control of the motor is effected by a small plug switch. Feed screws of different pitch are furnished for varying the speed of boring and a friction clutch protects the motor should any particularly hard obstacle be struck suddenly.

The columns are made in different lengths and each is adjustable for about two feet variation. The construction of the drill and its method of mounting enable the operator to drill close to



General Electric Rotary Coal Drill.

the roof, floors or walks as well as in any direction as above noted.

A series of tests with one of the drills were made at the Wm. A. colliery of the Connell Coal Co. at Durea, Pa., with the following results:

Material drilled.	Threads per inch on feed screw.	Depth hole.	Time.
1 Hard slate......	4	2'	30"
2 Hard slate......	4	2' 6"	32"
3 Anthracite coal.	4	2'	17"
4 Anthracite coal.	4	2' 6"	17"
5 Hard slate......	4	2' 1"	20"
6 Hard slate......	4	2' 6"	25"
7 Rock ("boney").	6	2' 6"	50"
8 Rock ("boney").	6	2' 6"	1' 34"
9 Hard slate......	4	2'	

Test 4 showed a rate of drilling of six feet in 48 seconds. Test 7 and 8 were made in a very hard rock, locally called "boney." It is about of the same nature as a very hard white slate. A heavy blow from a mine pick makes very little impression upon it, and it does not cut easily or chip.

After the above tests were made the drill was taken to a part of the mine where the floor was being blasted up to get into another vein. This floor consisted of very hard rock (boney). No breast augur or hand machine drill could be used in it. The holes that had been put in previous to the arrival of the drill had been put in by the hand jumper, one man holding the bar and the other driving it with a sledge. The two men could put in a hole three feet deep in from two to two and a half hours. There was a large amount of water in this part of the mine, and it was expected that considerable difficulty would be experienced in getting rid of of the dust and cuttings as the water runs into the holes as fast as they are drilled.

Two men placed the drill in position, handling the frame and drill together. Time for drilling the five foot hole was 3 minutes and 20 seconds. The augers when taken out of the holes were too hot to handle and had the appearance of having been pressed against a rotating grind stone, as fully ¼" was ground off. These augers had been so hardened that a file would not make any impression on them and they must therefore have met some very hard material. Five holes were drilled and blasted by two men between 1.30 and 4 p. m. and about 500 cubic feet of rock was loosened up ready for loading on to the mine cars.

The next day the drill was used for taking down 300 feet of roof along the main gangway commencing at the shaft. The width of the gangway was 8' 6"; average thickness of material blasted down three feet. Two men handled the drill, two men tamped the holes for blasting, and eight laborers took away the material. Two men put in 60 feet of holes from 8.30 a. m. to 11 a. m. tamping four of the holes in the meantime to allow two tampers to catch up. It was found that two men could easily drill holes faster than two men could tamp them for blasting. The nature of the material in the roof was hard slate and boney. All the holes were put in at an angle of from 30 to 40 degrees.

The smaller drill weighs with post complete only about 160 pounds, the drill itself weighing 100 pounds. In bituminous coal this drill shows a speed of drilling of 5 to 7 feet per minute with a six thread screw.

It will therefore be seen that these rotary drills meet the requirements of strength, lightness, capacity, ease of control, and adjustability, practicability and economy.

NEW YORK NOTES.

"Ideal" Insulated Wire.—Attention is called to the new "Ideal" insulated wire which is just being placed on the market by the Phillips Insulated Wire Co. This insulation, they claim, is superior to rubber insulation in many respects, as it will stand a very high insulation test, has a long life, as it will not be injured by atmospheric influences, and will not oxidize the copper wire. The wire is furnished in plain polished black, fancy black braided (for exposed wiring) and white fireproof finish.

Mr. A. A. Knudson, one of the patentees of the new "Ideal" wire, who has been devoting his time during the past summer at the Phillips Insulated Wire Co.'s factory at Pawtucket, R. I., in the interests of that wire, has returned to New York and is now identified with that Company in placing the wire on the market at their office, 39–41 Cortlandt street.

The H. & H. Electric Manufacturing Co., of 136 Liberty street, have recently equipped a factory at 22 and 24 Morris street, Jersey City, with every facility for the manufacture of motors, dynamos, arc lamps and search lights. They will also make a specialty of rewinding armatures and repair work on every type of electrical apparatus.

PHILADELPHIA NOTES.

The Fort Wayne Electric Co. have sold through its representative G. A. Wilbur one 1,200 light Slattery alternator with station appliances to the Lititz (Pa.) Electric Light, Heat and Power Co.; one 1,200 light Slattery alternator and a 4-circuit switchboard to the Merchantville (N. J.) Light, Heat and Power Co.; four 30 light Wood arc dynamos and 320 arc lamps to the Northern Electric Light and Power Co. of this city.

J. E. Bailey & Co., of Philadelphia, have lately secured the general agency for the "Eureka Oil Purifier," and report sales very satisfactory. This filter is new on the market, and embodies several very important improvements.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
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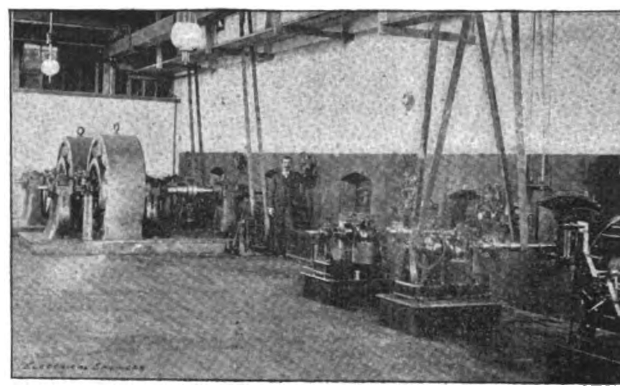
TRIPHASE CURRENT ELECTRICAL TRANSMISSION AT REDLANDS, CALIFORNIA.

THE city of Redlands, California, has had a growth perhaps more rapid than any other of the many towns that have suddenly sprung into existence in the West during the past ten years. In 1887, nearly all the land now included within the city limits, amounting to seventeen square miles, was virgin soil, while in the immediate neighborhood could be found at most some 500 people, forming the two little settlements of Lugonia and Crafton. To-day it is a prosperous town of between four and five thousand inhabitants, with well-paved streets, handsome residences, substantial business buildings, and an unexcelled climate in which flourish some of the best oranges to be found on the Pacific coast. Manufacturing interests, too, are represented, and the natural advantages of the place have recently led to the establishment of an electric plant, supplying both light and power at rates comparing favorably with those in the east, although coal sells at Redlands for $11 a ton.

The Redlands Electric Light and Power Company, organized something over a year ago, saw in Redlands wonderful possibilities as a manufacturing centre, and so shaped their policy that by furnishing electric power at reasonable rates, utilizing the exhaustless water supplies in the vicinity, capital might be induced to build shops, factories, and residences, to the benefit of the town, the state, and incidentally, the company itself. The range of mountains just north and east of the town, is the highest in Southern California and is rich in streams of spring water offering in their abrupt fall and constant flow abundant opportunity for the development of power. The first steps of the company, therefore, were toward securing control of sufficient water power for their purpose. Mill Creek was selected as best suited to their needs and all the land over which it flows for the distance of two miles, including the old channels, was purchased. The stream is

THE POWER HOUSE AT REDLANDS.

diverted from its course on the lands of the company about nine miles east of the centre of the town and above the point whence water is taken for irrigation. A dam of masonry forty feet long built across the channel and securely anchored to the bed-rock, cuts off the stream from its natural bed and directs it into a tunnel 160 feet in length cut through the cliff, and affording excellent protection for the intake, head works and pipe line. At the end of the tunnel is a sand box seventy-five feet long by twenty-five feet wide to catch any sediment carried from the stream before it can enter and clog the pipe line. The latter is made of steel rivetted sections thirty inches in diameter. It is 7,250 feet long and has a total fall of 353 feet to the power house. Here the line ends in a large iron receiver whence the water is led to Pelton water wheels, to whose shafts generators are directly connected, and, having done its



TRIPHASE GENERATORS IN THE POWER HOUSE.

work, is discharged through a rock-paved ditch back to the bed of the creek to be used for irrigating purposes. A pole line, well and substantially built, distributes the current to consumers throughout the town and vicinity.

The power house contains at present two 250-kilowatt triphase generators, each directly coupled to the shaft of a 200-h. p. Pelton wheel; two exciters, each capable of energizing the fields of both generators if necessary, and one arc machine with a capacity of fifty 2,000-c. p. lights. These latter machines are also directly coupled to Pelton wheels. By this arrangement, when the stream is at its lowest there is developed at the generators 800 h. p. The pressure at the nozzles of the wheels is 160 pounds to the square inch and the pipe line is capable of delivering 2,400 cubic feet of water a minute.

The large generators are of similar pattern, each operating at an armature speed of 600 revolutions, which, as the fields have 10 poles, gives 6,000 alternations a minute. Their rated output is 100 amperes at a normal pressure of 2,500 volts. Both generators and exciters are so arranged as to be run in parallel, and do so quite to the satisfaction of the company.

Though but a short time has elapsed since the plant started, there are now in operation 30 arc lamps about the town and 1,000 incandescents of 16 c. p. Besides these the Union Ice Company, a large concern supplying nearly the entire coast with artificial ice, has contracted for 150 h. p. to be delivered twenty-four hours a day for twenty-five years. This is supplied by a 120 kilowatt motor especially designed by the General Electric Co. It has eight poles and runs synchronously with the generators at a speed of 750 revolutions, or 6,000 alternations a minute. The ice house is four miles and a half from the power house and the motor is started by first short circuiting the fields until

the machine is brought into synchronism with the generator, and then cutting in the exciter. It has thus far proved perfectly satisfactory and the tests show a high degree of efficiency for the entire plant. Other manufacturing concerns besides the ice company, have contracted for power since the success of the latter installation has become assured, and several triphase self-starting induction motors without commutators or collecting rings are now being put in various parts of the city.

No transformers are used except directly at the points were light and power is delivered. A 2,500 volt circuit of No. 0 wire runs from the station to Redlands, a distance of eight miles, where it changes to one of No. 6 and No. 8 wire about the town. The lights and small motors are operated at 110 volts and the ice company is supplied from a separate circuit.

No description of this interesting plant would be complete without a word in regard to the men whose good judgment, skill and untiring effort have produced the first thoroughly successful electrical transmission plant in California, and whose example is sure to be soon followed by other enterprising spirits. The company was incorporated on October 8th, 1892, with H. H. Sinclair, president; Geo. H. Crafts, vice-president; F. G. Feraud, secretary, and the First National Bank of Redlands, treasurer. They deserve a word of mention. Mr. Sinclair is a native of New York, and was admitted to the bar of that state before going to California. He was also at one time engaged in business in this city. During his six years' residence in Redlands he has been active in local politics and has taken a keen interest in the welfare of the town, serving for four years on the city council. Mr. Crafts is an old Californian who has lived in the valley for thirty years. He has large landed interests throughout the state and was one of the leaders in the development of Redlands, and Mr. Feraud is one of the younger business men of the city whose former experience eminently fits him for the duties devolving upon him. These three, with Mr. George B. Ellis, one of the most progressive men in Redlands since its founding were the original promoters of the enterprise. They attempted a remarkable piece of work, presenting, at the time, many and serious difficulties and—they succeeded.

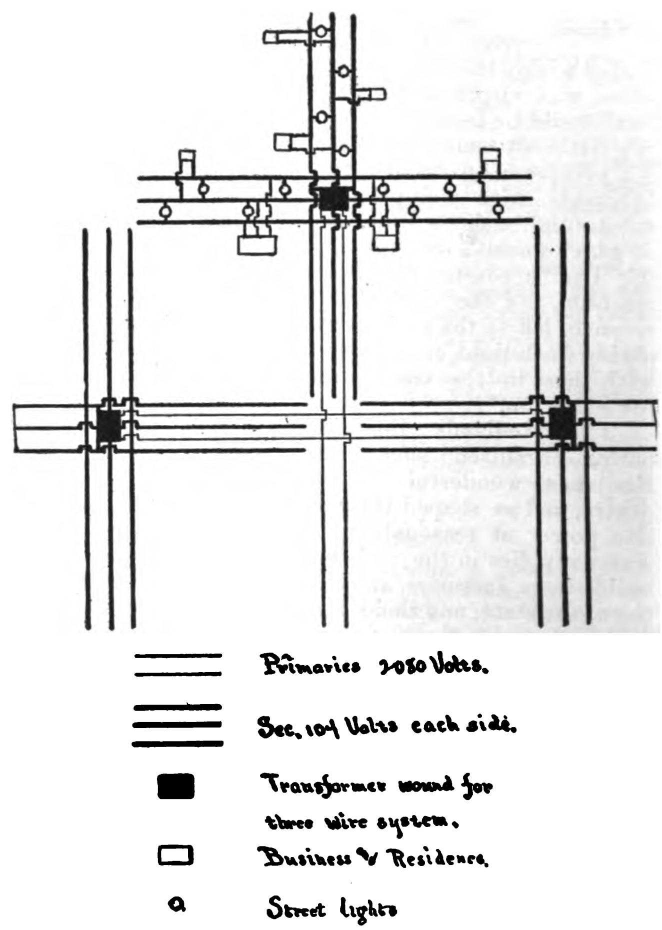
ECONOMY IN SMALL CENTRAL STATION LIGHTING.—TRANSFORMERS ON A THREE WIRE SYSTEM.

A NEW central station has just been installed for the Peterborough Electric Light, Power and Heat Company, at Peterborough, N. H., which is a distinct departure from the ordinary central station installation, embodying features worthy of consideration by those contemplating new central stations or extensions of old. The company is organized under a charter with a capital stock of $25,000, the officers and directors being John E. Gale, president, Haverhill, Mass.; A. W. Ives, vice-president and general manager, Boston, Mass.; and H. E. Gale, secretary and treasurer, Haverhill, Mass.

A reliable water power was secured on the Nubanusit River about four miles from the centre of distribution, from which a 2,000 volt alternator furnishes current to large transformers wound especially for the Edison three-wire system, and so distributed that each transformer furnishes service for street, commercial and residence lighting within a radius of several hundred feet. General Electric apparatus is used throughout, operated by Rodney Hunt Turbines.

The advantages of combining a high potential feeder system with a three-wire distribution is apparent by a glance at the accompanying diagram. The loss in feeder between centre of distribution and transformer is reduced to a fraction of one per cent., while the utilization of one large transformer in supplying many customers effects a large saving in service installation, first cost per light, and efficiency, with the attending advantages of an ability to greatly over-wire, owing to the peculiar conditions of residence lighting. The secret of success in the operation of small central stations is in covering the entire field, making the service universal and catering to the small resident consumers of two or three lights as well as the larger ones. Heretofore this has not been the general practice, owing to the construction and installation expense. The adoption of the above system of distribution, however, makes the small customer at once accessible and a source of profit. Should any particular branch of the system become overloaded it simply remains to sub-divide the secondaries by another transformer installation, thereby doubling their capacity.

This plant has been in successful operation at Peterborough during the past three months, the construction account being materially lessened by its adoption and the



TRANSFORMERS ON A THREE WIRE SYSTEM.

distribution is so perfect that the variation in potential throughout the entire town in less than 2 per cent.; this result being obtained with an actual saving in first cost for construction over the ordinary installation.

The advantages resulting from the use of the three-wire system of distribution from transformers are much greater than appears at first sight Hitherto, as a rule, a separate transformer has been installed at or near the building of every consumer, but by the method herein described fewer transformers are used and greater efficiency obtained at a lower cost per light for transformers. The most important saving, however, is in the greatly reduced amount of copper wire used. A three-wire installation using 52 volt lamps will show an actual saving in copper of 56 per cent. over a two-wire installation under like conditions, while a three-wire system using 104 volt lamps will show a saving of 79 per cent. over at wo-wire system using 52 volt lamps, a percentage so great that it is hardly affected by the greater

efficiency of the 52 volt lamps over the 104 volt lamps. A great economy is also effected by the decreased proportion of cut-outs, switches, wiring devices and labor required owing to the great reduction in the size of wire necessary for such an installation. Another distinct advantage may be gained by installing two transformers in series, in which case, should an accident occur to one, the other will carry its half of the system, thereby preventing all the lights from being out at one time.

The merits of the system above described will no doubt lead to its adoption by other central stations.

ARC LAMP DESIGN.

BY

ALTHOUGH the arc lamp is to-day one of the most important pieces of electrical mechanism, yet it undoubtedly receives less attention from an engineering standpoint, than any other like device of equal commercial value; this can hardly be accounted for, as the arc lamp field is certainly a very interesting one.

Although numerous experimenters have devoted their attention to the physical properties of the arc, such, for instance, as its counter-E. M. F. and temperature, but few have dealt with the more practical side of the problem, viz., the best method of feeding the carbons, and general design, including guiding statistics of faults to be eliminated and such other things as would be a help to the electrical engineering profession.

Probably, this partially accounts for the small number of arc lamp manufacturers as compared with manufacturers of motors, dynamos, etc., as, in the latter case well-seasoned rules and formulæ are laid down as a foundation; whereas, in the former case one has but to notice faults, if any, in present forms of apparatus and experiment until improved modifications are a result. It is thus evident that any such improvements are almost universally due to the labors of each individual manufacturer.

As before stated, in dynamo and motor design, we have infallible rules and mathematical formulæ to assist, so that we know beforehand what to expect from the finished machine; but not so in arc lamp design as each individual make of lamp requires a special controlling arrangement. There are no special rules to follow as regards the resistance or number of ampere turns required for this regulating magnet; these must be suited and proportioned to the other feature of the mechanism; neither are there any definite ratios of series to shunt coils as regards their respective resistances or strengths.

It also depends upon conditions whether solenoids or electromagnets with stationary iron cores be used to the best advantage; the former are generally preferable on account of their wider range of steady movement, although in using the latter, good results in this direction may be obtained by using properly shaped pole-faces and armatures. A greater strength of field would result for an equal expenditure of energy, although this would seem to be a matter of little importance in an arc lamp, as but a small fraction of the total current is utilized for regulation, and by the use of a leverage this may be still further reduced, as the distance from fulcrum to magnet increases.

In the matter of efficiency or preference of design between a differential and non-differential feed, the latter is undoubtedly the better on account of its ability to operate steadily, irrespective of the current strength, the main current having nothing whatever to do with the regulation and in this respect doing away with short hissing arcs or "pumping," due to weak or strong currents.

For constant current working, however, the form of lamp should contain a device to allow carbons to come together after burning, or to place a low resistance shunt around the same, for, were the carbons all raised and nothing but the high resistance shunts in circuit the dynamo would fail to produce current, being a series wound machine. For constant potential working this is of lesser importance, as the initial E. M. F. is greater than that ordinarily required by the shunts during operation; although a cut-out should be provided to open the shunt circuit and prevent overheating should the carbons be consumed or fail to feed.

No distinction is made in this article between rack or clutch feed lamps, or lamps wherein the carbons are fed by the unwinding of a metallic band or chain, as these are all but subdivisions of one general principle, and the electrical features of all are identical and subject to the same rules. They all undoubtedly have their points of excellence, but any of the above-mentioned forms may be constructed so as to burn very steadily indeed.

A lamp should be designed so as to burn with a practically uniform length of arc, from time of lighting until extinguishing, and afford as constant a light as possible during operation. The writer has noticed arc lamps which, when started, would burn with a short arc, but if left for a length of time would be found to have a long flaming arc; on investigation the shunt coils were found to be exceedingly hot, and according to the well-known law, the resistance increased with the heating, which in turn diminished their attractive power, by lessening the current, and allowed the difference of potential at the carbon points to equal that at the shunt coil terminals. This of course, results in a very unsatisfactory light, and should be religiously guarded against.

Another instance of similar nature was that of an arc lamp originally trimmed with heavy carbons and adjusted at the time to burn an arc of normal length, but when the carbons were greatly reduced the arc was of considerable length.

These defects in design are more noticeable in series arc working where the machine allows for increase of voltage, but in constant potential working as on incandescent or railway circuits they are of lesser moment, if the lamps are of the differential type, as the weakening of the current, due to the increasing lengths of arc, would reinforce the shunt coils partially by decreasing the action of the series magnets, thus compensating in a measure for the faults mentioned.

In a properly designed arc lamp, however, faults like the above should not appear, as the resistance of the shunt coils should be high enough to prevent undue heating, and the mode of suspension of the carbons and the internal arrangements should be such as would be affected but little by the gradual decrease in weight due to the consumption of the carbon. For this same reason a lamp should be adjusted for length of arc when about to feed, as then the whole weight of carbon and rod is about to be released from its support.

To sum up, the best foundation design for an arc lamp for direct current working would undoubtedly be that of the non-differential variety, with proper cut-out and mechanical details and in which faults, as before mentioned, would be totally left behind.

For alternating current working the conditions are different. In this case the arc should be formed as slowly as is practical between carbons of equal length or their equivalent, all magnet cores should be carefully laminated, and any closed secondaries which would be likely to be used, as for instance, metal magnet spools, should be broken up to prevent heating and other efficiency reducing losses.

In conclusion, it is to be hoped that more work of investigation may be done in this line by persons having time and means at their disposal and their labors recorded, in order that all interested in this important branch shall be benefited.

LIGHTING THE BOSPHORUS.

A Greek engineer is said to have just elaborated a great project of lighting by means of the electric light the whole of Constantinople, all the Bosphorus, from Cavak as far as the historical village of San Stefano, upon the Sea of Marmora, by means of three very powerful generators to be erected upon the three points of the Bosphorus where the current has an extraordinary force—at Arnaout-Keui, Candilly, and Serai-Bournou, at the entry of the coast port of the Sea of Marmora. The project has appeared to be so practical and feasible that a company of capitalists has been formed, the necessary funds subscribed, and a request for a concession has been addressed to the Turkish Government. The latter has taken the project into serious consideration, and, without losing time, has nominated a commission to examine the details and draw up an official report.

SELF-INDUCTION AS A REMEDY FOR STATIC DISCHARGE.

Referring to the article by Mr. P. B. Delany in The Electrical Engineer, of Nov. 1, on the early use of electromagnetic devices for increasing the speed of telegraphic transmission, I remember distinctly the line referred to, and, although in no way connected therewith, was cognizant of the use of electromagnets for the purpose mentioned. I believe Mr. Edison took out a patent for some arrangement of the kind, reference to which, and to the subject generally, will, doubtless, be found in the *Telegrapher* or *Journal of the Telegraph* along about 1868 or 1870.

The use of non-inductive leaks at various points along the line has also been frequently tried. I happen to have in my desk at the present moment one of the numerous carbon resistances, used twenty or more years ago between New York and Buffalo.

There is no doubt that the intelligent use of these devices does materially increase the speed of transmission—the electromagnet principally by neutralizing the static of the line, the non-inductive leaks by facilitating its discharge. Unfortunately, they are not very desirable things to have in circuit on land lines at out of the way places or where access to them is difficult for any portion of the time.

Objections to their use are, perhaps, not so strong in connection with underground or subaqueous lines where the insulation is not subject to great variations. With many stations along such lines and high speed an essential, they could advantageously be employed. Up to the present time, however, repeaters have, except for chemical telegraphs, been the mainstay in practical work. Of course, for long cables without intermediate, and with only terminal, offices their use has been out of the question. In such cases the aim has, therefore, been rather toward proportioning the conductor and insulating material in such a manner as to get the lowest capacity and the lowest conductor resistance practicable.

Your readers are, doubtless, familiar with the improvements that have been made in telephone cables during the last few years whereby the capacity has been reduced from about .2 to less than .07 microfarad per mile. This is a marked advance, but there is still a wide field to cover before the ideal cable is realized with its good insulation, low conductor resistance, and with its capacity of whatever magnitude it may be, completely neutralized for all frequencies. I do not know that this can be attained. I fully concur, however, in Mr. Delany's belief regarding the advantages to be derived from low conductor and comparatively low insulation resistance. If only some material as permanent as gutta percha or rubber, but of much lower specific insulation, could be found, it would be most valuable, far more so, in fact, as I have often remarked to parties presenting wires for tests, than the very high insulation they advocated and to which they attached so much importance. G. A. Hamilton.

In a recent article in The Electrical Engineer on the subject of "Self-Induction as a Remedy for Static Discharge," Mr. P. B. Delany expresses the opinion that fast speed signaling over long cables could be brought about by simply decreasing the resistance of both the conductor, and of the insulating material of the cable. Strong confirmation of this opinion is apparently afforded by the daily experience obtained on ærial lines equipped with automatic machinery. The speed on the Wheatstone automatic circuits, for instance, has been materially increased by the mere substitution of copper for the less conducting iron wires; while every rain storm which produces a uniform distribution of "escape" throughout the line tends to augment the rate of working, which is generally accompanied also with an improvement in the quality of the signals.

It would be natural to suppose therefore that the attachment of artificial leaks at various points along a line would lead to somewhat like results under the normal conditions of working, and Mr. Delany's practical experience while developing the chemical system referred to in his article, proved this to be the case, especially when electromagnetic leaks were used instead of inductionless ones.

It is a fact, however, that so far as the Wheatstone automatic system is concerned similar devices (applied on a small scale) have been tried with results that do not appear to justify a more extended application of this principle to Wheatstone circuits. Many of the latter are permanently equipped at the opposite terminals with adjustable leak resistances varying from 5,000 to 30,000 ohms, including an inductive receiving apparatus of about 1,200 ohms, inserted for the purpose of recording the outgoing signals. The attachment to, or withdrawal from, the main line of these leak circuits appears to have no appreciable effect either upon the speed or legibility of the signals. It is possible that a more extended, and better proportioned distributive appliance would result differently, though it is doubtful if the practical benefits derived on wires of comparatively small capacity and operated at speeds limited by the mechanical and electromagnetic inertia present, would ever make the game worth the candle.

Upon long underground or submarine circuits the case, of course, would be different and the problem of converting a very low speed into a comparatively high one, may be satisfactorily solved in the manner proposed by Prof. S. P. Thompson; but in view of the almost insuperable difficulties of both a mechanical and financial character that would attend the construction of such cables, some less complicated structure based upon the lines suggested by Mr. Delany—a poorly insulated but high conducting wire—would seem to be more desirable for telegraphic purposes. W. Finn.

Leaks in which inductive resistances are placed are undoubtedly beneficial on high-speed automatic telegraph circuits such as referred to by Mr. Delany, but they will not answer for quadruplex or any other circuit where the current is of variable strength. The reason is probably because the induced currents from an electromagnet do not increase or decrease in the same ratio as the static charge or discharge of a line. That is, a line when operating on 80 milliamperes, having its static capacity neutralized or balanced by electromagnetic leaks, would require readjustment of the leaks if the current changed to 40 milliamperes.

Regarding the theory advanced, that if the insulation of a cable was less perfect, the speed of signaling could be increased, I have my doubts. If the insulation were less perfect, more current would be required and the effect of increased current or E. M. F. may be more disastrous than high insulation. The fact that poorly insulated ærial lines can be worked faster than those having high insulation does not convince me that the same effect will be obtained with poorly insulated cable conductors. "W."

ELECTRICITY IN ADVERTISING.

In the report of the paper read before the New York Electrical Society, under the above title the name of the author, Mr. D. McFarlan Moore, was inadvertently omitted.

WORLD'S FAIR DEPARTMENT.

THE GERMAN HISTORICAL EXHIBIT IN ELECTRICITY BUILDING.

One of the most remarkable features of the World's Fair was the manner in which Germany contrived to give prominence to herself and to the exhibitors from her industrial and art centres. The Fatherland could not possibly be forgotten by its children when they saw its achievements and memorials on every hand. In some departments, Germany outstrove her competitors from abroad. This was particularly the case in Electricity Building, where Germany was far ahead of both England and France in the scope and interest of the exhibits. Moreover, not satisfied with the examples shown of modern products, the German authorities gave us mementoes and relics of the earlier days of the art, and, indeed, nothing more interesting could be found in the whole building than the dais in the gallery

The German Historical Exhibit in Electricity Building.

where what was called the German historical exhibit was shown. It is true that as a matter of fact it was largely devoted to the glorification of the name of Siemens, but if that name be not entitled to the height of praise then we know none that is. Here were the abundant evidences of an active brain and a busy life, both devoted through long years, and by more than one member of that distinguished family, to the upbuilding and uplifting of all the great modern arts of electricity.

Around the exhibit hung medallions of Gauss and Weber. In the centre, on a huge pedestal, under the transept window, beneath a canopy, was a fine bust of Werner Siemens, giving with fidelity all the wonderful vigor and mobility of his intellectual countenance. Flanking this right and left, at more modest elevations, perhaps because their claims to priority are not quite so clear, were Soemmering, of the galvanic telegraph (1809), and Reis, of the make-and-break (chiefly break) telephone (1861), whose life story has been so well told by Silvanus Thompson. These smaller busts were graced with evergreen shrubs, while on the steps of the Siemens pedestal lay big green wreaths. Right in front of it in a glass case was the Siemens dynamo-electric machine invented by Mr. Siemens in 1866, a date from which so much that is genuinely modern and useful must be regarded as starting. To the right was another epochal piece of apparatus, namely the first Siemens-Halske electric locomotive, dating from 1879, with its familiar Siemens construction and long train of solid gears. Beyond this again, in the central space was an old dynamo with Siemens I armature and water-cooling devices, now so remote, yet once so apparently necessary. On the other side of the dais were two old Siemens dynamos, multipolar, one of the usual alternating type, the other quarter-phase but indended to deliver a continuous current at the brushes. Some further account of this would have been interesting if immediately obtainable, but visitors went away with only the information that a dirty label vouchsafed.

Surrounding the exhibit were two L-shaped tables, on which were displayed a great variety of smaller apparatus. One piece was the first machine with Von Hefner Alteneck's drum armature. Adjoining it was a unipolar, without date, and just beyond was the oldest flat ring Siemens-Halske machine. Nearby again was another quite interesting piece of apparatus, namely, a Siemens-Halske alternate current boring machine, extremely massive, but very like many of the later attempts in the same direction. In close companionship lay an old Von Hefner Alteneck differential arc lamp, and then came a whole crew of "flat deck," inclined carbons, stand, horizontal and other forms of arc apparatus, supported by Werner Siemens' selenium photometer of 1877, and much other apparatus of the same nature. Our modern range finders had also a prototype here in Siemens' "distance meter" of 1868.

Across the aisle, we enter the domain of telegraphy and telephony, and are carried back to the dial telegraph of Siemens in 1847 and 1856, and through many improvements down to his polarized relays of 1856 and 1859. After this came a batch of Morse keys designed for the use of solid, phlegmatic Germans with heavy fingers, but capable of lots of good work, and these were succeeded by the Siemens-Halske cable key of 1868 and the Werner Siemens submarine relay of 1859. In close proximity is a model of the first gutta-percha press of 1848, and then came an old electric railway gong and an antique inductor for an induction bell. Adjoining this were shown an old Siemens-Halske electro-dynamometer, a control galvanoscope, a water level indicator of 1866, a "universal galvanometer" of 1868, an ozone tube, a Siemens mercury unit, old resistance boxes, etc. Next came some of Reis's telephone apparatus of 1861, and some old and cumbrous Siemens telephones. There were also a rotating interrupter, and an electric log of 1881-2.

A separate section, though not so grouped, consisted in some details of the Frankfort-Lauffen transmission apparatus. One piece was the Schomburg three-petticoat oil insulator, and another the frame of fine copper fuses used in the same work. There were also several photographs illustrating the generating plant at Lauffen and the receiving plant at Frankfort.

A number of inventions and dates have been included above, some of which are familiar to the reader, and many of which are now embalmed forever in the historical treatises on the electrical arts. But it is stimulating to see so much ground covered under a single presiding genius, and while these are emphatically days when all the tendencies are against such comprehensive effort in all branches, they are also days when there is a strong desire to do justice to the men whose work, like that of Siemens, lies at the founda-

tion of modern electrical industries. A full and interesting sketch of the life of Werner Siemens, with an autograph portrait, will be found in THE ELECTRICAL ENGINEER of Dec. 24, 1892.

THE PATENT OFFICE ELECTRICAL EXHIBIT IN THE GOVERNMENT BUILDING.

OUTWARDLY, the U. S. Government Building at the World's Fair was one of the ugliest and most forbidding; inwardly it was one of the most attractive and interesting. In the latter days of the Fair when the scramble of competing purchasers for choice exhibits had left its marks and tickets everywhere else, it was a positive pleasure to walk through a building where all the exhibits were of a high order of excellence yet where one was not insulted or mortified at every step by a forcible reminder of one's own poverty and some luckier fellow's wealth. "Sold to Mr. Million of Emporia" or "Bought by Mrs. Parvenu of Oshkosh," were not the signs that ornamented the U. S. Building, although there were many things that money would gladly have purchased if it could, and which, perchance, it may yet have a chance at, if the Government income goes on falling short and the wind has to be raised somehow.

Many departments of work in and around the building were of interest to electrical engineers, such as the Signal Corps exhibit or that of the Naval Observatory, or that of the Hollerith electrical population-counting apparatus from the Census Bureau; but of most value and importance was the small but compact exhibit of the Patent Office. It did not fill many cases, and the floor area was quite insignificant compared with that given up in some other buildings to soap and chewing gum, but it was a very forcible and striking illustration of the range and fertility of American invention in electricity. Perhaps a little more skill might have been shown in grouping, and a plain guide would have been extremely serviceable; but the labels were at least legible and in some instances details were given at considerable length, as in the Delany multiplex telegraph.

It was interesting, for example, to find a number of models showing the early stages of arc lighting in America, including the patents of C. F. Brush back to 1879 and covering both his well-known clutch mechanism and his devices for operating two or more pairs of carbons in a single lamp. Here, too, were models of motor arc lamps devised by Van Depoele in 1884, just at the time when he was leaving that somewhat restricted field for the wide domain of electric railway work. Here, too, were early patents of Sawyer, Maxim and Thomson-Houston, the first-named coming up to the point of incandescent work (1880) with a lamp in which the pencil was sealed in a globe filled with nitrogen gas. Nor must we overlook this old Jablochkoff model of 1877, of "electric candles composed of two sticks of coal arranged in a suitable case, and separated from each other and from the case by an isolating fusible powder or material." Early also is that of W. Wallace (Dec. 18, 1877), a lamp in which there is a pair of carbons, each presenting an extended edge parallel to its companion's. By way of curious contrast, this case contained also devices at the other extreme of the modern art, embracing Wurts' lightning arresters and Shallenberger meters.

We come next to models and details of early dynamos of Edison, J. J. Wood, Eickemeyer, Van Depoele and Maxim, the last of whom would certainly have added to his fame as an electrician had he only pursued this line of work instead of being lured away by machine guns and dirigible ballons. In another case was the Griscom motor of 1880, familiar to many old stagers, with its "Siemens bobbin" armature and its "field magnet closely surrounding the armature." In this case was more dynamo machinery and apparatus for regulation. Moses G. Farmer was represented by a patent of 1875, on a self-exciting machine in which cast iron is used in the place of wrought iron for the reason that it holds a large amount of remanent magnetism. The U. S. patent of 1871 to Gramme is characterized as the earliest in this country for a magneto electric machine having a continuous armature winding. Much of Brush's early work is here noted, as well as that of Fuller. We find also, the Wilde patent of 1866 and the Lontin of 1869. This case contained a number of motors, such as those of Neff (1851), Berlioz (1866), Davenport (1837), Lillie (1850), Page (1854), and many another worthy of the pioneer motor days.

Telegraphs and telephones were not forgotten and many early obsolete forms were displayed in the cases. Alexander Bain was here, for example, with his patent of Dec. 5, 1848, an apparatus for copying surfaces by the electric current through a single conductor by paper prepared with prussiate of potassa. House was also represented with his patent of Dec. 28, 1852, and M. G. Farmer with his printing telegraph of 1856, and his duplex of 1858. G. M. Phelps, the senior, was in evidence also with his patent of March 23, 1875, a printing telegraph embodying the beautiful work and mathematical refinement and delicacy of proportion that stamped all his notable inventions. The Cowper autographic telegraph of 1879 was also shown, and other inventions from abroad like Muirhead's quadruplex of April 27, 1880, or the Wheatstone receiver of Dec. 22, 1874. Printing telegraphs crop up again under the names of Edison (1873) and Hughes (1856) and Elisha Gray (1875). In case 28 we stumbled upon A. G. Bell's telegraph of 1875, Elisha Gray's prophetic electric telegraph for musical tones (1875), Bell's celebrated patent for a telegraph (Jan. 30, 1877) in which are embodied the details of a speaking telephone; Gray's harmonic telegraph of 1877, and his speaking telephone of May 21, 1878; with these go several of Edison's telephone inventions, as well as those of Dolbear, Phelps and other early workers. It would have been better if in this class and in the others the arrangement could have been consecutive, but it is plain that very little money or space was at disposal, and that a brave and not altogether unsuccessful effort was made to bring together models of genuine interest.

It may not be out of place to mention that in other parts of the Patent Office exhibit some of the models were driven by little electric motors, in order to illustrate their principle of operation. The visitor closed the circuit with a tiny switch and the printing press or whatever other machine it happened to be, started off at once. The effect was very happy and gratifying, and this use of electricity was but another forcible illustration of the manner in which all over the Fair in all sorts of unexpected ways and places, electric light and power were resorted to by enterprising and quickwitted exhibitors to obtain the best results.

STORAGE BATTERY HAND CARS.

MR. JOHN WHITAKER, the master mechanic of the Jacksonville and Atlanta Railroad Company, Jacksonville, Fla., while in Electricity Building was greatly interested in the exhibition of the electric dog cart, but was disappointed to find that no attempts had been made to equip storage battery hand cars for railway work. He remarked to the writer that every railroad now had its lighting plant, often a large one, and that it would frequently be an economy to use part of the current in charging batteries for such a purpose, and thus also make an economy in the power and number of men employed in running such cars. He could himself use such a car, and knew of many other master mechanics and line superintendents to whom they would be highly serviceable. Mr. Whitaker will be very glad to hear from any persons or companies likely to be interested, and will lend all the aid in his power to the furtherance of such a result as adding storage "hand cars" to the modern railway equipment.

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VOL. XVI. NEW YORK, NOVEMBER 15, 1893. No. 289.

THE INCREASE IN MUNICIPAL ELECTRIC LIGHTING PLANTS.

WHILE we have not yet found any occasion or reason for changing our oft-expressed opinions as to the undesirability of municipal investment, in America, in electric lighting plants, we must confess our surprise at the extent to which this method of spending public money has gained popularity. In this country, outside of New England, the growth of the movement is still slow, due to the fact, probably, that faith in the honesty of public officials is weak and that socialism has little hold upon a people who prefer to do everything for themselves. But if we look abroad we find a different state of affairs, and the observer of events is struck with the rapidity with which in England, for example, the local authorities are now establishing municipal plants. There is a possibility that but for this new form of expenditure of taxes, electric lighting might still languish in England as it has done these ten years past; but be that as it may, it certainly is noteworthy that no fewer than 120 local bodies have applied to the Board of Trade for Provisional Orders to supply electricity.

Looked at a little closer, the English figures are remarkable as evidencing a belief in the electric light that was scarcely to be expected on the part of conservative and prejudiced corporations, and which can only be attributed to the enormous success attained in this country under private enterprise. During 1893, in 14 towns and cities the local authorities have voted in favor of municipal electric light loans to the extent of $2,500,000. In 11, preliminary hearings have been had as to the spending of $1,500,000; and in 22 the Local Government Board (the central authority) has authorized the raising of no less an amount than $3,300,000. Altogether, these 47 communities in a single year have taken action looking toward the investment of nearly $7,500,000 in electric lighting; and it is said that at this moment some 35 municipal plants are actually in course of erection.

The results obtained with the plants already in operation are said to be encouraging. If this be true, it must be largely due to the wisdom of the local authorities in securing professional advice and assistance, a thing which our local companies are still unhappily loath to do, whether on construction or for purposes of inspection. It is stated that at Bradford, the profits for the first half year reach $15,000. In Dublin, the profits of the first half year reached $4,300, and the whole year shows a healthy surplus. In Glasgow, the success has been so marked that large extensions are contemplated; and at St. Pancras (London), the original investment of $500,000 has been satisfactory enough to prompt to further outlay. Moreover, the disposal of refuse in dust destructors as part of the scheme is an inviting element of economy to municipal authorities. Of course, it would be desirable to get fuller information than is generally given out, as to the details of receipts and profits and the distribution of charges common to several city departments; but the supervision of the English Board of Trade is probably too sharp to allow of the fallacious figuring one finds sometimes in reports from American municipal plants.

Turning to this country, it cannot be said that anything like the same activity is shown here. We have already ventured two reasons for the difference, and a third explanation may be the inability in the recent times of panic and depression to float new municipal bonds. It is a fact, for instance, that the Detroit plant, contemplating a cost of about $600,000 has been kept in abeyance until the money market became easier; and we think that it is likely to be vigorously pushed, now that the clouds have lost their silver lining. Prof. Barrett, who has charge of the municipal work in Chicago, informed us recently that he had very extensive work in contemplation, in areas of the city hitherto untouched, and that they would be dealt with on a basis of direct local assessment. In Minneapolis a sentiment exists in favor of a municipal plant, and it is reported that several of the aldermen are about to force the issue. These are the most conspicuous cases at the present time, but it seems to us likely, that with the early revival of financial confidence, plans for buying or starting city plants will multiply. Our readers will find this movement, involving so many economic and social problems, worthy of study; on many of them, it may be thrust in a disagreeable manner.

Storage Batteries and the Trolley.

FOLLOWING close upon the paper read before the American Street Railway Association at Milwaukee, on the availability of storage batteries in connection with railway power plants, we print in this issue a description of the first plant of this nature actually put into operation, that at Zurich, Switzerland. The many practical advantages of the arrangement are pointed out by Dr. Schoop, and leave little doubt as to the economy of the system in many situations. The installation described is a small one, it is true, but the results obtained are significant.

ELECTRIC RAILWAY DEPARTMENT.

A SUCCESSFUL COMBINATION OF STORAGE BATTERIES WITH THE "TROLLEY."

BY

D. Paul Schoop

THE combination of dynamo and battery with an electric light installation has already proved to be economical and practical in a great number of central stations, especially on the continent of Europe. As is well known, a saving of fuel is realized on account of the steam engines working constantly at full load and therefore avoiding the low efficiency of the engine and dynamo at light loads. The first cost of plant is often the same in both cases whether the plant be erected with, or without, a battery, the boilers, engines and dynamos being required to be only one-third of the usual capacity, with the battery combination. Considering the variations of load of a lighting plant in comparison with those of an electric railway line, it must be obvious, that if ever a battery has proved good with the first, it must prove better still with a railway line. While, as a rule, the maximum load with a lighting station is about two to three times that of the mean load, the maximum in a railway power station is often five times as great as the average work. This is especially the case with lines of a limited number of cars and having gradients of some extent.

Such is actually the case at Zurich, Switzerland, where two lines are in course of erection and this led the Oerlikon Works to try the system described below. The question to be solved, was: Is it possible to combine a storage battery with the trolley system in a safe, practical manner, and what is the saving in the first cost of plant and in the working expenses of such combination?

It was shown from the calculation of the line at "Hirslanden," that the average power at the central station was 35 h. p., the minimum descending to 19 h. p., the maximum increasing to 70 h. p., that is, under normal conditions (clean rails and in summer). With snow and frozen streets, the power required is, of course, larger, and might increase to nearly double these figures. The plant for an ordinary trolley system would consist of a steam engine of 50 h. p. with a corresponding boiler and a dynamo, giving about 60 to 65 amperes at 500 to 550 volts. Another similar plant was provided as a reserve and connected so as to work in parallel with the first, in case of emergency. The steam engines were high speed, 250 to 300 revolutions, and the generators compound machines running at 500 revolutions.

The consumption of the engine per horse-power hour is:

Pounds steam at full load	30
" " " 1/2 "	35
" " " 1/4 "	40
" " " 1/8 "	50

A slow-speed engine with a condenser (Sulzer, Winterthür) of 50 h. p. takes 17 lbs. of steam per horse-power hour at full load and 23 pounds at quarter load. Of course, the fast running engine is better adapted for railway service, since it regulates much quicker for variations in load. Nevertheless, with the rapid changes the regulation is not at all such as to guarantee a practically constant voltage on the line and the engine suffers from the thousands of shocks every day. The consumption of fuel might be reduced considerably if an economical slow-speed engine could be employed. Instead of a reserve plant of the same capacity, a battery might serve as a reserve and as a regulator, enabling a reduction to be made in the size of boiler and dynamo and the adoption of slow-speed engine, working all the time at full load and at its best efficiency.

In the present case, a battery of 270 cells, combining the features of the Oerlikon battery with those of the Tudor cell, was adopted. Each cell consists of three positive plates, 0.3 metre long and broad and 8 mm. thick, and four negative plates of the same size and thickness. The plates are hung directly on the glass jars and insulated from each other by glass tubes half an inch in diameter. The capacity of the battery is 140 to 150 ampere hours and the battery stands a discharge of 35 amperes during three to four hours, according to whether the discharge is continued without interruption or whether it takes place during a period of eight or more hours. The discharge may be 75 amperes during a little more than an hour, if necessary.

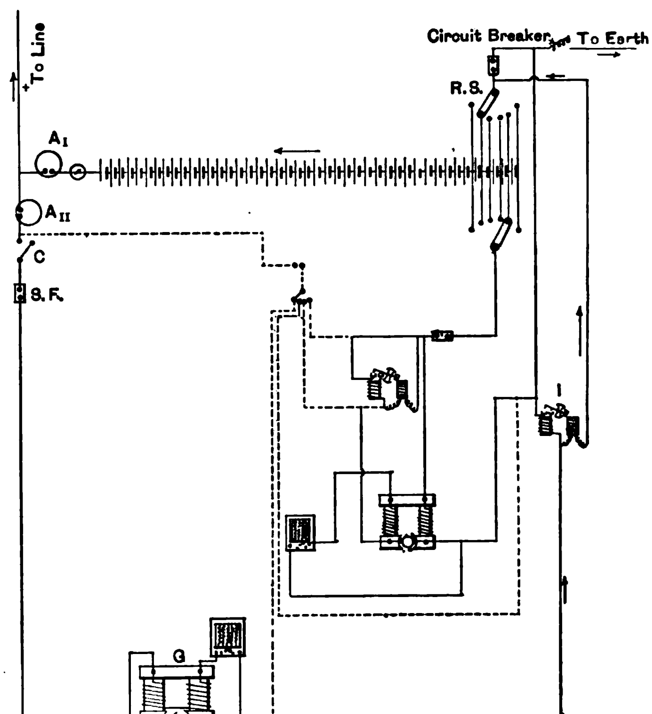


FIG. 1.—ARRANGEMENT OF STORAGE BATTERIES IN RAILWAY POWER STATION.

This battery, therefore represents a reserve of 70 k. w. hours, nearly 100 h. p. hours, and may deliver 37 k. w., or 50 h. p., during an hour at least. If necessary, 100 k. w., or 75 h. p. may be discharged, this being the maximum discharge and corresponding intervals of not more than five minutes. The whole work on the tram line can therefore be taken care of for a period of three hours by the battery alone, and may, in case of any interruption or accident to the engine or dynamo, instantaneously be taken out of the battery.

All the cells are mounted on the same level, which admits of easy control. A careful insulation of the battery is necessary. Fig. 1 shows the general arrangement and connection between the generator and the battery. The generator G, which need not be a compound machine, but is preferably a shunt dynamo, sends the negative current first through the automatic switch I, which breaks the current in case the tension of the battery becomes higher than that of the generator (which occurs when the engine is stopped or the line suddenly becomes inactive) and which again closes the circuit, as soon as the tension of the gen-

erator is greater than that of the battery. Having passed this switch, the current goes to the discharging lever of the regulating switch B S, entering the battery near its negative end and, after passing ammeter A I (showing the charging or discharging current of the battery), ammeter A II (showing the current of the generator), a cut-out C and a safety fuse S F, returns to the positive pole of the generator. The battery is directly connected to the line, the positive pole being connected to the overhead wire while the negative, by means of the discharging lever, is connected to the rails, a safety fuse and a circuit braker being between the rails and the discharging lever.

The last 81 cells near the negative pole of the battery are in connection with the regulating switch, having 28 contacts; three cells are always inserted between contacts. A relay, placed between the overhead wire and the rails, brings the self-regulating switch into action when the line tension drops below a certain limit, the discharging lever moving to the right-hand side, adding cells to the battery and thus maintaining the tension; and when less current or no current is used on the line, the discharge lever moves to the left, cutting out cells. Since the generator works at a uniform speed and with *always the same* power, the battery *discharges* when more power is required on the line, and is *charged* when less power is required on the line than the generator furnishes. It will be seen, that the cells near the negative end of the battery are thus only discharged and not charged again. A simple way, to bring these cells to the same condition as all the other cells, is to charge them separately by means of a second smaller dynamo. Twice a day, say, at noon and before shutting down, current is sent from that dynamo from the negative pole through an automatic switch of exactly the same construction as described in connection with the main generator, through a safety fuse and an ammeter to the charging lever, passing from there through the cells between the two levers of the regulating switch, leaving the discharging lever and returning to the positive pole of the small dynamo. The outer cells having been comparatively little discharged, they will soon be fully charged and cut off from further charging by moving the charging lever to the left, till both levers stand at the same point. In this case, the small dynamo is short circuited and gives no more current and the automatic switch interrupts this circuit. If the small dynamo excited directly from the two levers is constructed of soft iron and has a corresponding characteristic, it is not necessary to regulate the field resistance, but the dynamo tension follows the tension between the two levers of the regulating switch.

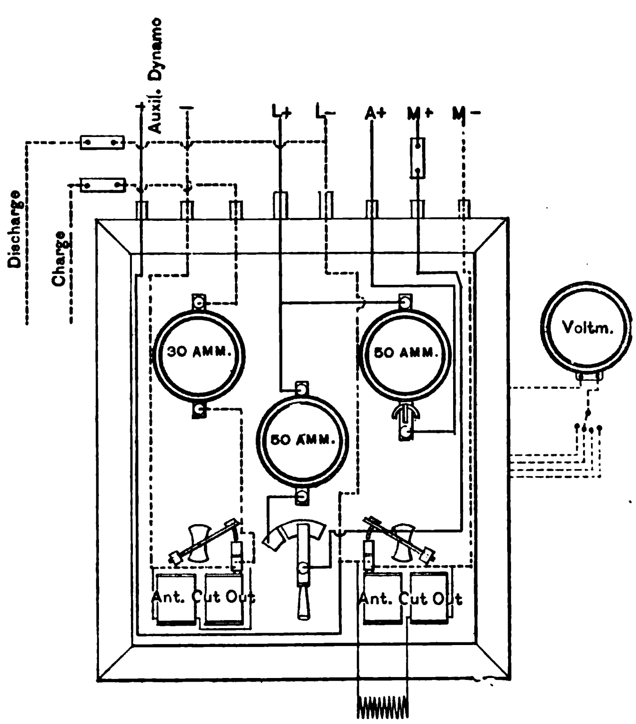


FIG. 2.—ARRANGEMENT OF SWITCHBOARD.

Fig. 2 gives a diagram of the switchboard, which requires no detailed explanation. Between the positive pole of the battery and the trolley wire, an ampere recorder is inserted (of Richard Frères, Belleville, Paris). This instrument records with great exactness the variations of charge and discharge and thus enables one with the help of a planimeter, to ascertain the actual charge and discharge of the battery. It gives a constant indication of the state of the battery at the end of the day and affords a means of regulating the engine the next day so as to charge up the battery full by the next evening.

The battery should always be kept at about 80 per cent. of its capacity during the day and be completely charged during the last few hours. The position of the discharging lever also shows to what extent the battery is charged. It is worthy of note that the described combination does not absolutely require a self-regulating switch. Trials with the battery at about 70 per cent. of its capacity showed that the regulating power is practically the same with or without a regulating switch. A difference of potential between the poles of the battery of 10 volts was sufficient to charge or discharge the battery. To give an example: The line tension was 510 volts, the line absorbing at that moment 25 amperes, exactly the output of the generator dynamo, and the battery was neither charged nor discharged. Suddenly 50 amperes were absorbed by the line and the line potential fell to 500 volts, the battery giving out 25 amperes. As soon as the line was interrupted the whole current of the generator went into the battery, the tension of the line being now 515 volts. There is no question that this regulation is good enough; but as soon as the cells are near the complete charging limit, the regulation becomes bad. A battery having already 90 per cent. of its capacity stored up gives double, or more, difference of potential between charge and discharge and a fully loaded battery gives nearly 20 per cent. difference.

The advantage of the self-regulating switch is, that the battery can be kept at nearly its full capacity and yet at good regulation, therefore having the whole reserve at one's disposal at any time. It is also evident, that the durability of the battery is increased by keeping it charged up. Where not so much stress is laid upon the capacity or reserve of the battery, a cheaper Planté battery serves just as well and regulates sufficiently. The price of the described battery with all the necessary switches and instruments (the erecting and everything connected with it included) is about $4,000; while that of a Planté battery and without the self-regulating switch might be $2,500. The work of the above described combination is quite satisfactory; all the current beyond what the generator furnished, was instantaneously given out by the battery and the regulating switch, within a second, could add or cut-off 40 volts of the potential. It was found, however, that the discharging lever only moved over two contacts at the heaviest work of the line. The following table gives a trial trip:

Time. Hours.	Line Current. Amp.	Line Tension. Volt.	Dynamo Current. Amp.	Battery Discharge. Amp.	Battery Charge. Amp.	Number of cells.
10.20	..	510	20	..	20	250
21	60	500	20	40	..	253
21¼	30	505	20	10	..	253
21½	25	510	20	5	..	250
22	23	510	20	3	..	250
22¼	..	510	20	..	20	250
22¼	70	500	20	50	..	253
22½	40	500	20	20	..	253
22¾	..	510	20	..	20	250
23	..	510	20	..	20	250
23¼	35	510	20	15	..	250
23½	50	505	20	30	..	250
23¾	70	500	20	50	..	253
26	90	500	20	70	..	256
26½	..	510	20	..	20	250

Since the tension of the line remains practically constant with this combination, the cars start quicker than they do with the trolley system without battery. One could easily feel the difference in starting by cutting out the battery from the line.

The advantages of the combination described are: 1. It is possible to use comparatively small motor powers for the operation of electric railways; which means a considerable saving of working expenses. 2. With the application of steam, slow-speed engines can be used, affording greater economy in fuel and less depreciation of the engine plant. 3. The first cost of plant is less expensive, since the reserve plant commonly provided for may be eliminated and the size of the plant throughout need only be one-half or less of that without the battery. 4. The steam engine as well as the dynamo work at their best efficiency. 5. The cars start quicker on account of the constant potential of the line. 6. In bad weather, in winter, when snow and ice nearly block the tracks, the battery may deliver current far beyond its normal discharge power, thus avoiding stoppages on the line. 7. If anything happens to the engine or dynamo and the machines must be stopped, the line is provided with current from the battery, according to the size of battery, during three hours or more. Therefore the greatest safety of the working of the line is guaranteed. 8. With tram lines including heavy gradients of some length, the economy with this combination amounts to a 4 per cent. increase of income on the whole business. Where the line is level, the saving still increases the income 2 per cent. 9. The battery, in connection with this combination, is independent of any system, since a Planté battery serves as well for the purpose. Most of the leading accumulator companies undertake to guarantee their batteries for this purpose at a yearly premium of 5 to 7 per cent. of the cost of the battery.

THE HENRY DIAGONAL SYSTEM OF TROLLEY LINE CONSTRUCTION.

BY

Frank Bourne

An article in the last number of your paper, entitled "Diagonal System of Overhead Trolley Construction," by John C. Henry, has attracted my attention on account of the many "errors of omission" which it contains. The "Comparative Cost of Constructing One Mile of Trolley Line" is, in the writer's estimation, very misleading, and a better plan to analyze this arrangement is by considering the subject under the different conditions of electric railroad installation.

First, in city work, where street traffic is great. On lines of this description, where a conduit system is not used, there will be at least three or four feed wires suspended from the poles, usually from 400,000 to 500,000 c. m. each, these feeders being used for feeding sections of the line beyond the point under consideration.

Taking first, the question of the cost of poles, by the diagonal system it would necessitate the use of greatly increased cost in individual poles, on account of having to install poles of much greater strength and height. The strain on the poles would be enormously increased, due to the feed wires and the relative position of adjacent poles. In other words, what are known as curve or corner poles would have to be installed. This strain would be still more increased by the accumulation of sleet and snow in winter. When feed wires are run along one side of the street, as in ordinary span construction, the strain on the poles due to feed wires is nearly in the direction of the axis of the poles, and where the poles are raked from the street, say, about eight inches, this strain in a measure counteracts the strain of the span wire. The easiest, cheapest and most durable path to follow with all wires is a straight line.

Without going into close figuring, the poles of this description would have to be at least 75 to 100 per cent. heavier than in ordinary construction. In the table of cost given, the labor of running feed wire is given at $75 per mile. In the case under consideration, of city work, it would be impossible to run feed wires diagonally during the day time without stopping traffic entirely, as every feed wire would have to be run across the street between each support; consequently all labor of stringing wires would have to be done between midnight and five or six o'clock in the morning under conditions which would increase the cost two or three times over that of running feed wires during the day.

Now, considering the trolley wire and maintaining it at an approximately uniform height from the track, street railway contractors appreciate the difficulty of maintaining this level under the conditions of ordinary span wire construction. If a heavy feed wire were substituted for the span, the sag would be enormously increased, necessitating the use of special attachments to poles, and increased size of poles,—of course, presuming that the span wire would be in the form of an insulated feed wire, the weight of which would be considerably increased in winter, as explained above.

Taking the ordinary span wire construction on a 40-foot street, with poles 120 feet apart, and substituting the diagonal system, it would be equivalent to constructing a trolley line on the street 126 feet wide, as the span wire would be suspended between two poles 126 feet apart. Any one who has attempted to run a span wire on a street of this width will appreciate the money which would have to be expended to make a workmanlike line without an enormous sag; consequently we consider the cost of the method prohibitive.

Second, in considering country work, where wooden poles set in earth are generally used, and substituting the diagonal system, it would be advisable to set all poles in concrete and also increase their size at the top, for the reasons explained above. This, without any other consideration, would double the cost of each pole set. The article in question also states that "this system dispenses with one half the number of poles and reduces the strain on the remaining ones." I fail to see how the strain is reduced by the method considered. The appearance of the line built diagonally would be an objectionable feature of the system, from the standpoint of the public.

In ordinary line construction, the trolley wire is anchored at short intervals by means of double bridles, which prevent any serious displacement of poles should the trolley line break. As regards the feed wire line on the side of the street, the poles carrying the same are head-guyed where advisable, so that in case of the break of a feed wire, the resulting strain is distributed over several poles. The diagonal system does not allow of the simple method of anchoring the trolley line or head-guying the poles. By the ordinary method, where two or three feeders are used, each feeder acts in a measure as a head-guy to keep all poles in place, presuming any displacement of one feeder is caused by a break in same. The simplest way to compare the two systems on these points is by drawing a diagram of the two arrangements, and to assume a broken wire at any point, and then the result will be apparent.

In the article under consideration, the details of construction are very brief, and the originator may have special devices and arrangements to obviate all the defects which we have criticised. In considering the subject, we have just taken the article as it stands and would be very pleased to have an explanation of this construction which would remove all the defects and give us a system which would cost less than the present one and be as efficient. It is something we are all looking for.

THE HENRY DIAGONAL SYSTEM.

The diagonal system of overhead trolley construction suggested by Mr. John C. Henry in the Engineer of November 1, is very ingenious and certainly shows a marked saving in first cost. The objections to this style of construction are principally the unsightly appearance of the work, and the increase in the liability of broken wires falling in the street. I think Mr. Henry is certainly mistaken in his statement that the strain on the poles would be reduced by this arrangement. It seems to me that it would be greatly increased, and that the fluctuations in the strain on the feed wire caused by the passage of the trolley would greatly increase the tendency to break in the feed wire, which, if parted, would fall directly in the street.

It would also be more difficult to preserve a straight line for the trolley by this method of construction, as adjustment of the position of the trolley would be more likely to be required and would be much more difficult to accomplish than by the present construction. The comparative importance of such points and of the saving effected, can, however, only be positively determined by a reduction to practice.

H. Ward Leonard.

Mr. Henry claims reduction in cost by dispensing with one half the poles and the large number of insulators, etc. In order to enable one to judge of the system properly he should supply details as to how he proposes to anchor this continuous hard drawn suspension wire at each pole and give some proof of why this system reduces the strain on the fewer poles remaining than there would be upon them when the same weight is supported by twice as many poles.

Mr. Henry should also explain how the diagonal system

"keeps the feed wires away from trees," and give his reasons for preferring a hard drawn copper span wire, when disastrous results have occurred with that kind of span wire, on one or two prominent railways.

J. STANFORD BROWN.

NEW YORK CITY.

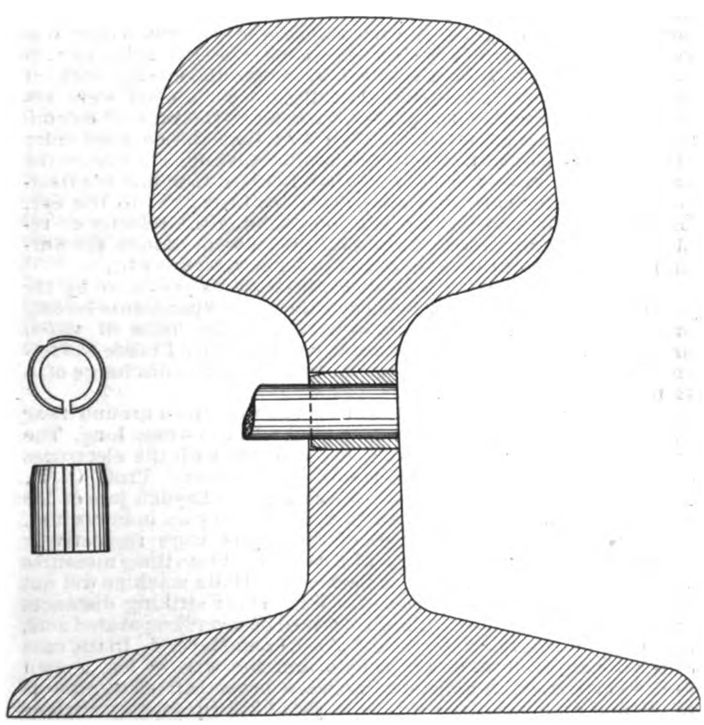
It does not appear from Mr. Henry's article whether he has tried to stretch a No. 0000 heavily insulated wire between poles 250 feet apart. Is not this what would be required in case of taking care of a feeder system of any magnitude? He seems to calculate only for one feed wire, No. 00, B. & S. This means a very light service. I have, unfortunately, no time to go into the matter in detail, but it seems to me that the matter of lengthening the span wires is in itself something not to be lightly undertaken, and the heavy feeder systems which are now so frequently required would, I believe, make it necessary to provide other supports than poles 250 feet apart. The lengthening of the copper circuit involved in the use of feed wires as span wires may figure out all right when the amount of copper which is to be handled is small, as in the case assumed, but surely the extra expense of copper would soon be a matter of much concern, as the amount of copper required, even over the shortest possible line, increases to what it ordinarily is, namely, something over a single No. 0000 wire up.

O. T. CROSBY.

NEW YORK CITY.

RAIL BOND SPRING BUSHING.

THE best method of connecting the return circuit on electric roads is attracting a great deal of attention at present. In the early days of electric roads this matter was not given the attention it deserved. While it has been recognized that a perfect return circuit was needed, yet the means for making provision for such return have often been very imperfect and unsatisfactory. The rail bonds frequently did not make a perfect joint; the one piece bond was found expensive and, there being no head to drive, it was found almost impossible to use it; the channel pin was hard to drive and unsatisfactory as it was bound to come out in the course of time.



RAIL BOND SPRING BUSHING.

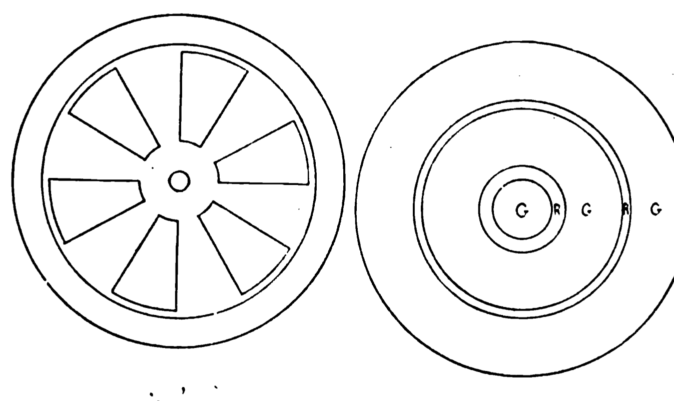
The Railway Equipment Company, of Chicago, have studied this important matter, and realizing the necessity of providing an economical, practical and absolutely perfect connection, doing away with the possibility of corrosion, oxidation or electrolysis—in fact, making such a solid joint that no air or moisture could possibly enter to destroy the connection—have lately brought out a new rail bond spring bushing which bids fair to become standard in the art. The device is shown in the accompanying illustration. The bushing is a steel tube and measures $\frac{1}{32}$ of an inch larger than the hole in the rail; an opening in the bushing measures just $\frac{1}{32}$ of an inch. When the bushing is put on the wire and driven in, the opening closes tightly, making practically one piece of the rail, bushing and wire. As a needed addition to the equipment of electric raads, this device would seem worthy of investigation.

MISCELLANEOUS.

STUDIES OF THE PHENOMENA OF SIMULTANEOUS CONTRAST-COLOR; AND A PHOTOMETER FOR MEASURING THE INTENSITES OF LIGHTS OF DIFFERENT COLORS.[1]—II.

BY PROF. ALFRED M. MAYER.

Increase of the purity and luminosity of the contrast colors by a rotating screen.—Make a disc of white card-board of 27 cms. in diameter, with eight sectors cut out of it, and cover it with translucent paper so that the paper extends beyond the disc and makes a border 3 cms. wide. A circle of 8 cms. in diameter is left in the centre of the disc and a ring of 1½ cm. on its border. This disc is shown in Fig. 8, but with only six sectors. It should have eight. It is placed between the lamp and the window, and rotated with a velocity of one revolution in about 1¼ seconds, while it is viewed on the side facing the window. The blue sectors thus take successively the places just before occupied by the sectors of orange yellow and the effect is to heighten the contrast-color in such a remarkable manner that the blue sectors by their more intense color appear separated from the rim and central circle and appear in a plane farther from the eye than the plane of the centre and rim. On the side of the



FIGS. 8 AND 9.

disc illuminated by the lamp the same effects are produced, only they appear more marked. A change will also be observed in the hue of the advancing and following edges of the sectors, on both sides of the disc; the advancing edges appear more saturated in hue than the following edges.

A mode of observation by which contrast-colors are intensified.—Simultaneous contrast-colors are generally viewed by placing gray or tinted surfaces on colored grounds, or by the juxtaposition of colored surfaces. The effects thus produced are of such constant occurrence in the paintings of artists, and in colored fabrics, that their study is of great interest. The contrast-colors thus produced have generally been studied by simply placing on a colored ground smaller gray or tinted surfaces and observing these with the unaided eye. This method has been improved by H. Meyer[2] who viewed the gray on the colored ground when both were covered with white transparent paper.

The mode of observation I have devised for the study of contrast-colors is as follows: A glass tube of 2.7 cms. in interior diameter and 10 cms. long is coated on the outside with black Japan varnish, so as to have reflection only from the interior surface of the tube. A ring of 3 cms. in diameter with a central opening of 2 cms. is cut out of gray paper. The gray of this ring was matched on the rotator by a disc having 57 parts of ivory-black and 43 parts of white Bristol board. This ring, placed on a surface of emerald green appears of a rose color. If at the distance of distinct vision we look at the ring through the tube we shall see the ring by direct vision inclosing a circle of emerald green, and this inclosed by a rose colored ring, produced by reflection of the gray ring from the interior of the tube, and surrounding this ring is another of emerald green, as shown in

1. From the *American Journal of Science*, Vol. xlvi., July, 1893.
2. Pogg. Ann., xcv., 170.

Fig. 9; in which R and R are the red rings and G, G and G, the circle and the two rings of emerald green.

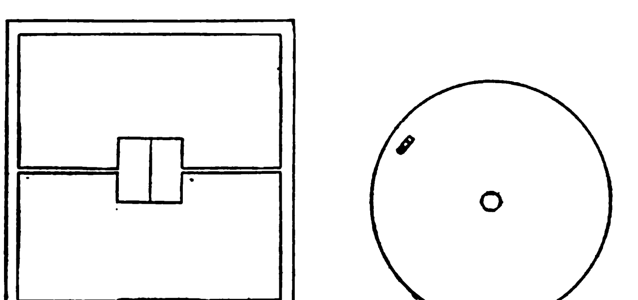
The hue of the rose-colored rings as seen through the tube is much more intense than the hue of the ring viewed on the emerald ground with the unassisted eye. Experiments made with the aid of an achromatized calc-spar prism, and by matching on a rotating disc the colors of the gray ring on an emerald green ground showed that the intensity of the contrast-color, as seen with the reflecting tube is nearly double what it is when viewed by the eye alone. The color of the ring when viewed by the unassisted eye was matched on the rotator by a disc having 30 parts of Chinese vermillion + 7 of "Hoffman's violet R. R. R." + 34 parts of ivory black + 29 of white Bristol board. As seen through the reflecting tube the match appeared to be given by 57 of Chinese vermillion + 15 of "Hoffman's violet R. R. R." + 28 of white Bristol board.

Another tube, 4.5 cms. in diameter and 18 cms. long gave excellent results, with two reflected rings, and on nearer vision with four reflected rings. A tube, suitable for these experiments is selected by closing one of its ends by a disc of card-board having a pin hole at its center. When the end with the pin hole faces the sky and we look through the other end we see bright rings caused by the reflection of the light of the pin hole from the surface of the tube. If these rings are circular and concentric the tube is of circular section and its axis is a right line.

The value of this mode of observation is shown by the following experiments. Place the ring of gray paper, or a circle of gray paper, about 1¼ cms. in diameter, on a surface painted with cobalt blue, not too saturated. The gray ring, or circle, appears of an orange tint. Place a similar gray ring, or circle, on a surface lightly washed with emerald green; it appears pinkish. The difference between the hues of the ring when viewed on the cobalt blue and the emerald green, though decided, is not strongly marked; but if viewed through the reflecting tube the ring on the cobalt blue appears of a rather intense orange and the ring on the emerald green appears of a rose color. When so viewed the difference in these hues is strongly marked.

Pieces of card-board, painted with the following colors, were arranged in pairs. Orange yellow on the less refrangible side of D, and orange yellow on the more refrangible side of D. Greenish yellow and yellowish green, both made with gamboge and Prussian blue. Purple of violet end of spectrum with added red, made with "Hoffman's violet R. R. R.," and violet between G and H, Young and Müller's fundamental color. Place a pair of the colors, as given above, side by side and on each put a gray ring, with a reflecting tube over each ring. When viewed by the unassisted eye the differences in hue are slight and difficult to define; but when viewed in rapid succession through the adjoining tubes the differences in hue are decided and may be readily matched in color with discs on the rotator.

The duration of the time of vision necessary to perceive contrast-color.—A square screen was made, as shown in Fig. 10, with a



Figs. 10 and 11.

square of card-board in its centre, 8 cms. on the side, surrounded by a square of translucent white paper, 35 cms. on the side. This screen was placed between the petroleum flame and the window so that its sides were equally illuminated. On the side facing the window the central square appeared cyan-blue. One-half of this square was covered by a strip of paper so tinted with orange yellow that it appeared gray when in juxtaposition with the other blue half of the square.

On a rotator were placed two superposed black discs of the same diameter (25 cms.). Near the periphery of each disc was cut out an annular slot, 4 cms. long and 6 mm. wide, as shown in Fig. 11. By turning one of these discs on the other the opening of this slot could be varied from 4 cms. to nothing. The rotator is so made that the time of a rotation of the disc can be held uniform and also accurately measured. On gradually narrowing the opening on the slit the duration of vision of the blue and gray square was reduced to $\frac{1}{1800}$ of a second, when the blue half of the square could not be distinguished from the gray half.

When the screen was illuminated by a more orange light, obtained by placing a sheet of orange gelatine between the lamp and the screen, the gray and blue were not distinguishable when the duration of vision was $\frac{1}{1800}$ of a second.

In these experiments I only get 11 6 flashes of light from the screen in a second, while the number of flashes required to banish all flickering from the screen was accurately measured as 46 in a second with the illumination of the lamp alone, and 43 in a second when the lamp-light traversed the orange gelatine film. These experiments show, what is well known, viz., that as the intensity of the light diminishes the duration of no perceptible change in the intensity of the residual impression increases. I found that the sensation of the light from a white cloud, seen, near

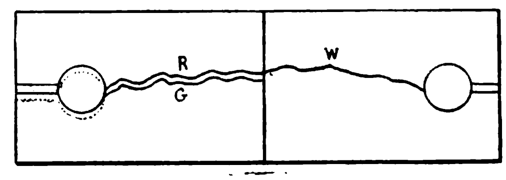


Fig. 12.

noon, through a north window on a clear day lasts only $\frac{1}{85}$ of a second before the residual effect diminishes.

A gray ring was placed on an emerald green ground facing the light from a bright white cloud. When viewed through the opening in the rotator the ring appeared pink on the green ground till the duration of the vision of the ring was reduced to $\frac{1}{8380}$ of a second, when the ring ceased to be visible on the emerald green ground; but so long as it was visible the contrast color was visible. I found that 48 flashes per second were necessary to render the vision of the pink ring and green ground steady, without the least flickering, while only 11.6 flashes per second were obtained in determining the $\frac{1}{8380}$ of a second as the time when contrast-color ceased to be visible. The fact that the contrast-color of the ring remained till the ring could be distinguished from the green ground gave the opinion that I ceased to obtain contrast-color because the narrow slit used gave too little light to the eye. On doubling the width of the slit and doubling the velocity of rotation the contrast-color of the ring reappeared, though the duration of vision was the same as in the former experiment.

Experiments on simultaneous contrast-colors produced by the flash of the electric discharge.—The foregoing experiments having proved insufficient to form any opinion as to the time of vision necessary to perceive simultaneous contrast-color I made the following experiments with the light obtained by the discharge of a Holtz induction machine.

1.) The gray ring was placed on the emerald green ground near a Holtz machine, which gave a very bright flash of 8 cms. long. The condensing surface on the two jars connected with the electrodes of this machine equaled 185 square centimetres. Prof. O. N. Rood[4] measured the duration of the flash of Leyden jars of 738 and 71 square centimetres of surface, charged by an inductorium. The durations of the discharges of these jars were respectively $\frac{1}{8700000}$ second and $\frac{1}{38000000}$ of a second. From these measures I infer that the duration of the flash of the Holtz machine did not exceed the $\frac{1}{10000000}$ of a second. With short striking distances between the electrodes the flash is formed of several separated acts, as shown by Henry,[5] Feddersen,[6] Rood,[7] and Mayer.[8] In the case of the discharge of a large inductorium the writer[8] has shown that when the striking distance between brass ball electrodes is only one millimetre, with a Leyden jar of 242 sq. cms. of surface in the circuit, the discharge lasts $\frac{1}{24}$ of a second and is formed of over 120 separate sparks; but as the striking distance is increased the discharge is formed of fewer and fewer components, till at a striking distance between 1 and 2 cms. the discharge is reduced to a single flash. In the following experiments the striking distance is 8 cms., and a single flash was given, whose duration we may safely assume was less than $\frac{1}{1000000}$ of a second.

In a dark room, at night, the flash of this machine gave vivid contrast-colors. The gray ring appearing bright pink on an emerald green ground, and of a bright yellow on an ultramarine ground. The after images of these effects lasted about ⅓ of a second.

2.) A rod was placed in front of a white card-board and the shadow of the rod was formed on the screen by a candle. The distance of the candle was such that the white card-board appeared equally brilliant when illuminated only by the candle, or, only by the electric flash. At the moment of the flash the appearance presented was very remarkable. From the shadow of the candle

4. Amer. Jour. Sci., Sept., 1871.
5. Proc. Amer. Phil. Soc., 1842.
6. Pogg. Ann., vol. cxvi, p. 132.
7. Amer Jour. Sci., Oct, 1872.
8. Amer. Jour. Sci., Dec. 1874.

appeared suddenly to shoot a dark screen, which had superposed the shadow of the candle, and which shot to the side of the shadow and appeared of a bright golden orange, while the apparently uncovered shadow of the candle appeared of a brilliant cobalt blue; to my eye exactly as though an opaque screen had been suddenly removed from a slit in the shutter of a darkened room, which slit was covered by a piece of cobalt glass.

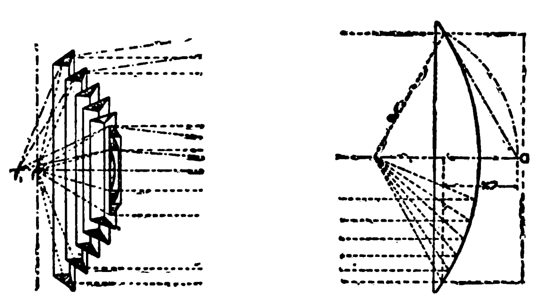
3.) A square of thin green glass, 4 cms. by 6 cms., was placed on a piece of thin silvered glass, 4 cms. by 12 cms., so that the edges of the green glass and of the silvered glass coincided. This arrangement gave a surface, half of silvered mirror, half of green glass. This apparatus was so placed that the electrodes of the machine and the flash were reflected from it to the eye. The room was dark. At the moment of the flash its reflection appeared as in Fig. 12. On the mirror the line of the discharge was white; W in the figure. The continuation of this line on the surface of the green glass appeared red (R in figure), though really white. In front of and parallel to this line was a green line, G, produced by the light of the flash reflected from the surface of the silvered mirror, and having traversed twice the thickness of the green glass. In this experiment we obtain contrast-colors in the source of light itself.

THE CONSTRUCTION AND USES OF PROJECTORS.—I.

BY F. NERZ.

THE efficiency of a projector depends (1) on the size of the "useful angle"—that is, the angle contained by the rays which are received by the extreme edges of the reflector or refractor, this angle being a measure of the amount of the light which is utilized by the projector; (2) on its capacity to transmit the radiation collected with the minimum of loss to the object to be illuminated; (3) on the nature of the source of illumination. The most important point is to determine the efficiency of the various optical devices possible with respect to the two former of the above considerations.

Fresnel was the first to introduce great improvements in lighthouse apparatus; his system has been applied also to projectors. A convex lens forms an admirable means of refracting rays coming from its focus in such a manner as to forward the rays in an approximately parallel beam so long as the diameter of the lens is small compared with the focal length; but it follows that only a limited proportion of the radiation can be utilized. If the useful angle be increased, the spherical aberration begins to become important and destroys the parallelism of the beam, and in addition to this the light becomes more split up into a spectrum, and the absorption increases in consequence of the increased thickness of glass. In order to avoid these drawbacks, Fresnel built up his lenses of concentric rings, and he surrounded these in addition with a system of completely-reflecting prism rings, in order to collect the light falling outside the lenses as well. In this manner he was able to diminish the spherical



FIGS. 1 AND 2.

aberration by choice of suitable radii of curvature, and the absorption in consequence of the diminished thickness of glass. The total reflection prisms also constituted a most valuable reflecting device; but in spite of these improvements, which still make the Fresnel apparatus the best for lighthouse work, the instrument is not entirely the most suitable for projector work in view of later inventions. It is difficult to make the glass rings so exactly that the foci of all are coincident, and they still retain spherical and chromatic aberration, and if the light gets displaced from the focus the reflected and refracted rays deviate in opposite directions from parallelism with the axis, and thus a considerable diminution of intensity is produced, as shown in Fig. 1.

A great step forward was made in the construction of projectors when Mangin showed that in spherical concave mirrors the deviation from parallel reflection could be almost entirely eliminated, if the inner surface has its centre of curvature nearer the mirror than the outer and reflecting surface, Fig. 2. By making it thus lenticular in form, the ray which falls on the mirror and is reflected by its convex side is refracted at the concave surface by an amount which can be made, by suitable adjustment of the magnitudes, to very nearly compensate for the deviation of parallelism by spherical aberration of the reflecting surface. The law was determined by Mangin, who found that the spherical aberration could be considered as eliminated when the diameter of the mirror was not greater than its focal length. In Fig. 2 is shown a mirror constructed on this principle in 1876; the radii were 120 centimetres and 160 centimetres for the concave and convex surfaces respectively, and the focal length was 101 centimetres. This mirror possessed the property of reflecting light emitted at its focus in a parallel beam in the highest degree up to that date attained. On the other hand on account of the great focal length, it could only use a source of illumination to a certain limited extent, its "useful angle" being about 60°. The next improvement made by Mangin and Messrs. Sautter, Lemonnier & Co. was to put lenses between the light and the mirror, and the useful angle was thus increased to 100°; but the improvement was not

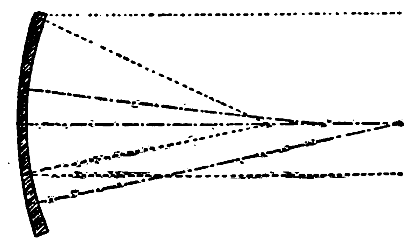


FIG. 3.

very practical and was soon given up, the focal length was reduced by choice of suitable glass, and the makers contented themselves with an approximation to the law given by Mangin.

Tschikolew, of St. Petersburg, was working at the same time on reflectors for projector work and returned to parabolic mirrors; but since these could not be constructed whole out of glass, he built them up of spherically-ground rings, whose centres of curvature lay on the point of intersection of the axis with the radius of curvature of that piece of the parabola which they were intended to replace; while Siemens and Halske attempted to improve on these by making the two centres of curvature as nearly as possible coincident. The construction of such mirrors is a matter of considerable difficulty; and they have, in common with the Fresnel apparatus, the drawback, that the foci of the component parts are not easily made coincident, and further, that at the joints considerable portions of the mirror are always rendered useless; and in consequence of these defects these mirrors, though they surpass the Mangin type in the proportion of the light reflected, are inferior in general utility.

The first rival to the Mangin mirror which really surpassed it was that of Schuckert, who in 1886 succeeded in evolving, in common with Prof. Munker, a process for making parabolic mirrors in glass out of one piece, and thus practically solved the question for all time.

Let us consider first a luminous point in the focus of a true parabolic mirror; all rays falling on the mirror will be reflected in a direction parallel to the axis, Fig. 3. If the light be of the intensity I, then the amount of light gathered by the mirror is $= 4\pi I \rho x$; where ρ is the radius vector of the edge of the mirror, and $2x$ is the subtangent of the corresponding point on the parabola, Fig. 3. The light so gathered by the mirror would be reflected as a perfectly cylindrical beam, and in a non-absorbent medium would travel to infinity without any diminution of intensity; at any given distance a circle of the size of the mirror would be illuminated, and if any object were brought into the beam, a true shadow picture would be projected to any distance. If the focal length be made shorter, the same amount of light can be taken up by a mirror of smaller diameter, and consequently since the area of the beam would be diminished, the intensity of illumination in it would be increased; but, of course, all this applies only to a perfectly parabolic reflector. Both Mangin mirrors and those constructed of spherical rings give, in consequence of their spherical form, a deviation from parallel reflection, and make a conical instead of a cylindrical beam, which produces a diminution of intensity with distance proportional to the increase in the area of the beam. A source of illumination confined to one point does not exist, and has no practical value. Even were it possible to recognize objects 1,000 yards distant, of which a surface equal to that of the mirror was illuminated, and if this surface could be sufficiently examined in one second, it would take about two hours to examine the whole horizon.

"THE PHOTOGRAPHIC TIMES," of 423 Broome street, New York, will excel even its usual high average of beauty and utility in a special Christmas number, which is to contain several photographic illustrations, 50 halftone cuts and 36 pages of original articles.

THE "UNIVERSAL" ELECTRIC LAUNCH.

The enviable position in public favor held by electric launches, whether for yacht tenders or independent pleasure boats, wherever power for charging is available, has brought into existence more than one new company, anxious to share the distinction of having done pioneer work in the perfecting of so important a branch of ship building as the industry is sure to become.

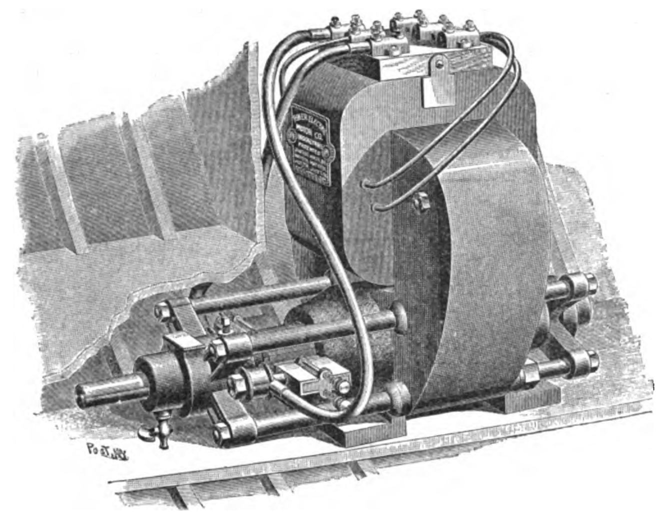
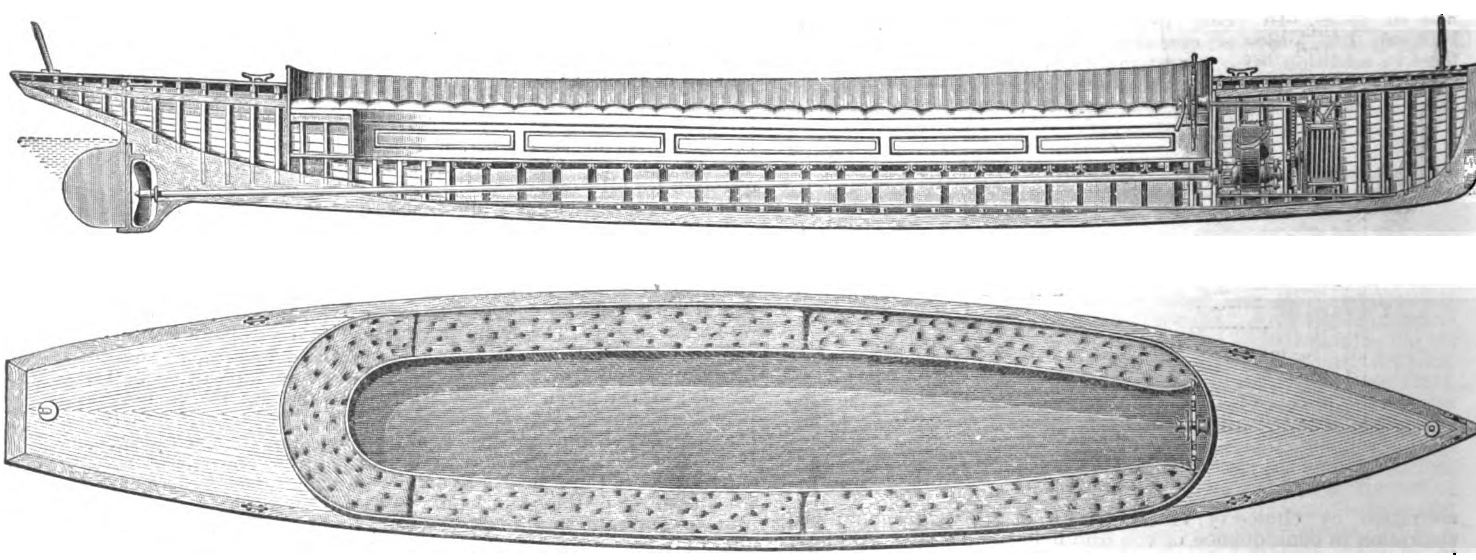


Fig. 3.—Riker Motor in "Universal" Electric Launch.

The Universal Electric Launch Company with works at Nyack, N. Y., and offices at 45 Broadway, this city, and 45 York street, Brooklyn, have been for some time past making a specialty of yacht tenders, auxiliary electric yachts, and independent electric cruising launches, and recently made an interesting test of a new 40-foot launch embodying their latest improvements. The boat is 40 feet long, 6 feet 6 inches in beam and normally draws 2 feet of water, giving a displacement of about three tons. It is equipped with 72 cells of battery, weighing 3,000 pounds and having a capacity of 150 ampere hours.



Figs. 1 and 2.—The "Universal" Electric Launch, Equipped with Riker Motor.

The accompanying illustrations, Figs. 1 and 2, show a sectional and plan view of the boat. The motor, a 10 h. p. Riker machine running at 600 revolutions per minute, as will be seen, is placed in the bow. The enlarged view, Fig. 3, gives a clear idea of its arrangement and the method of setting.

The general form of the machine, that of a letter "V," admits of its being placed under the forward deck in small boats or under the flooring in larger boats if desirable, where it is out of the way, yet easily accessible. The toothed armature is very low and near the keel, to which the machine is firmly bolted, and there is no vibration. The commutator is made entirely of copper and phosphor bronze with mica insulation; the shaft is finely finished on ground centres and accurately fits the journals which are made with a bushing of special bearing metal, and all machines are supplied with self-oiling bearings and carbon brushes.

These machines are thoroughly tested before being placed in the boats, and all the parts are interchangeable, and are made in a thorough and workmanlike manner.

The cells are arranged to be instantly changed from series to parallel or *vice versa* by a pull switch, as normal or high speed is required. During the test the launch made 5½ miles an hour with the batteries in parallel, giving a current of 20 amperes at 70 volts, and spurts of eight miles an hour with the series arrangement, by which 48 amperes at 140 volts are delivered to the motor. The test of speed was considered very satisfactory, especially in view of the fact that the boat had been in the water all summer and the hull was consequently very dirty.

This launch acquitted herself most gallantly during the storm that raged along the coast last August. She was at that time lying at anchor off Stamford, Conn., directly to leeward of a large naphtha launch, which, in spite of all the power of her engine, running at full speed to take the strain from the cable, dragged her anchor and drifted down upon the Riker boat. In order to escape a collision the latter was forced to slip her cable and rely upon her motive power alone. This maneuver was successfully executed. The launch forced her way directly against the heavy sea and the gale, weathered a dangerous reef and then, turning in the trough of the sea, ran out of danger into the canal. This is probably the severest test to which an electric launch has ever been subjected and her builders are justly proud of the achievement.

THE SUPPLY OF ELECTRIC POLES.[1]

Telegraph and telephone companies are becoming not a little alarmed at the rapid depletion of material for poles. Formerly, when poles carried but one or two lines of wire, very small ones could be used, but now nothing less than a pole 32 feet tall and eight inches through at the top end is available and the supply is getting very limited. The rapid consumption by telephone lines of small poles and the thousands of new poles cut each year are two important factors that the telegraph people have to face.

The only pole worth setting that grows in Maine is a cedar and these if well set and of good size will last a long time. Some on the line between Bangor and Calais have been in use over 40 years. The only trouble with a cedar is its brittleness in frosty weather. A large pole if filled with frost will snap like a pipe stem if any sudden thaw strikes it.

The supply of cedar has become so short that of late years a large number of chestnut from Massachusetts have been used. They cost a good deal of money, but are very handsome and durable. Some idea of the cost of poles can be had when it is known that the cost of wire and labor is equaled by the cost of the poles alone. A good chestnut 32 feet long is worth from $3 to $4 and they are scarce at these figures. Just what will be used for poles in the future is an important question. Cedar is the only wood grown in Maine that will last long enough to pay for setting.

With such an increased demand for chestnut poles they are likewise being cut off at half their growth, and they, too, will be available but a few years.

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1. Waterville, Me., *Democrat*.

PERSONAL.

MR. W. T. M. MOTTRAM.

W. T. M. Mottram.

MR. W. T. M. MOTTRAM has just been appointed by the Curtis Electric Manufacturing Co. their representative in New York State and New England, with headquarters in New York City. This is but another evidence of the manner in which the newer companies in lighting and railway work are rallying to their aid the men who have done good work in the past. Mr. Mottram has had a singularly interesting career, and for so young a man has been through a wide range of pioneer experience. He studied electricity under the able tutorship of Profs. Ayrton and S. P. Thompson, in London, and at the age of 18 entered the service there of the new Edison Electric Light Co. As an assistant to Mr. W. J. Hammer he took part in the installation in 1881 of the Holborn Viaduct central station—the first incandescent lighting station in the world to go into actual operation. He was then engaged at the Crystal Palace Electrical Exhibition in 1882, had charge of the plant at Waterloo station, and then was employed on the first plant put into the Houses of Parliament. In 1883 he went to Germany for the Edison Co. of Berlin, and returning to London in 1884, took charge of construction work on the Grand Hotel and the Hotel Metropole.

Attracted to the United States by the greater activity here in electric lighting, Mr. Mottram came hither in 1885, and for some time was engaged in central station work at Wilmington, Del. Thence he went to New Orleans, and at last into Texas, where he represented both the Edison and the Sprague companies, beginning in 1888 and working on through all the transformations into Edison General and General Electric Companies. About a year ago, Mr. Mottram resigned to accept the position of electrical engineer for the New Orleans Traction Co. A great deal of heavy work was contemplated, but the financial troubles enforced a cessation temporarily, and Mr. Mottram returned to New York. In joining the forces of the Curtis Co., he has a favorable opportunity to avail himself of a rich fund of engineering and commercial experience, with the help of the many friends whom his industry and fidelity have won for him.

OBITUARY.

MR. J. C. UPHAM.

MR. J. C. UPHAM, electrician for the Commercial Cable Co. at their main Atlantic cable station, Canso, Nova Scotia, died on the 2d inst. after a short illness, aged fifty-five. Mr. Upham was born at Castine, Maine, and was actively engaged in telegraph, telephone and cable work for thirty-seven years. He was connected with the Western Union Telegraph Company, the New England Telephone and Telegraph Company, and was one of the early associates of the late Mr. J. B. Stearns. He probably did more to introduce and perfect duplex cable working than any other man in America. For the last ten years of his life he was in the service of the Commercial Cable Company, and by his decease that company is deprived of a valuable employé. He was a man of high integrity and sterling qualities of heart and mind, possessed exceptional ability and sound judgment, and was greatly esteemed in all branches of the electrical profession.

SOCIETY AND CLUB NOTES.

BUFFALO ELECTRICAL SOCIETY.

AT the tenth annual meeting of the Buffalo Electrical Society, the following officers were elected for the ensuing year: President, Philip K. Stern; vice-president, Frank C. Perkins; secretary, Astley C. Terry; treasurer, Samuel Stewart; and librarian, John G. McNerney. Executive Committee, Frank Kitton, George A. Burnett, C. V. Boughton.

At the next meeting on November 16, president Stern will read a paper on "Electricity at the World's Fair."

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the meeting of the Institute on Nov. 15, the business of the evening will be a discussion of the report of the Special Committee of the Council on "Local Meetings of the Institute."

LETTERS TO THE EDITOR.

ARMATURE WINDING FOR HIGH TENSION MULTIPOLAR MACHINES.

IN THE ENGINEER of October 11, a writer who signs himself "W. R." states, that my armature winding designated "drum ring," which was described in your issue of August 23 is not new.

Fig. 1 represents my winding; Fig. 2 shows that which is claimed by the anonymous correspondent to be equal to mine, and which is described in the book of E. Arnold (*Die Ankerwicklungen der Gleichstrom Dynamo-Maschinen*, Berlin, Fig. 51). The difference between both figures is obvious; in my winding the straight cross connections are located *on the back* of the armature; in that of Arnold, all connections are made *on the commutator side*. The consequence of this difference is, that in my winding less wires are on the inner side of the armature than on the outer one; and that is just the important advantage of this winding.

In the issue of Oct. 11, the writer has dotted those straight connections, notwithstanding that these lines are drawn full in the book of Arnold. We read there (p. 21): "The connections in the front are full drawn, those on the back, on the contrary, are dotted, or not represented at all." Now, if in Arnold's armature the cross connections would be even on the back of the armature (which, as shown above, is not the case), yet this winding would still not be like mine, for it would represent a drum winding, whereas mine, as shown in the Fig. 1, is a combination of the drum with the ring winding.

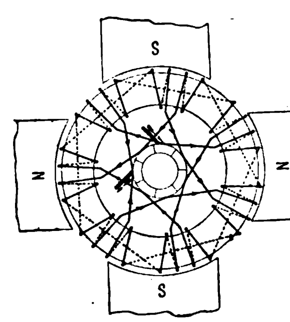


FIG. 1.

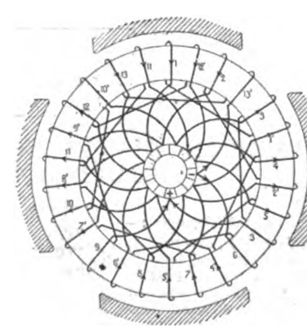


FIG. 2.

The drum winding of this kind is patented by Mr. Fritsche, but, nevertheless, mine does not infringe his patents. Therefore, I maintain my claims to priority.

L. BAUMGARDT.

VIENNA, AUSTRIA.

KINTNER'S SAFETY SYSTEM OF ELECTRICAL WIRING.

I HAVE been much interested in Mr. C. J. Kintner's paper on the "Safety System of Electrical Wiring" in your issue of November 1. The system proposed by Mr. Kintner seems unquestionably to be an excellent one. It occurs to me, however, that the chief features in Mr. Kintner's system were present in the system devised by Mr. S. Z. de Ferranti as early as 1889, or possibly earlier.

The principle of the Ferranti concentric cable is probably familiar to almost all of the electrical fraternity, and was, at the time of its first introduction, the subject of much discussion. It is to this very Ferranti cable that we owe the remarkable and for some time inexplicable "Ferranti effect." The boxing in of the commutator and brushes with the magnetic locking of the enclosing case at such times as the generator is in operation was also both proposed and practiced by Ferranti, it being his intention to have all the machines in the great Deptford station so constructed.

In a paper read by myself before the National Electric Light Association's Convention in Providence, in 1891, I made mention of and partially described both the concentric conductor proposed and to some extent used by Ferranti, and also the magnetically closed box surrounding the brushes. It is true that Mr. Ferranti did not propose to surround a commutator with this box, since Mr. Ferranti's machine was an alternator. In all other respects, however, it seems to be distinctly similar in general plan. It was also Mr. Ferranti's intention to ground the outer conductor of his concentric cable, thus eliminating any possibility of a discharge or static shock.

I trust that I may be pardoned for calling attention to what is perhaps a half forgotten matter.

CARYL D. HASKINS.

BOSTON, MASS.

A SAFETY SYSTEM OF ELECTRIC WIRING.

I AM delighted to see that Mr. Kintner has devised a system of wiring which will render accidents to life and damage to property from the deadly isolated plant a thing of the past. It will hardly detract from the admiration which must be accorded so beautiful and necessary an improvement in the art to know that Mr. Andrews, in England, has had in use for some years a concentric system of wiring in which all the difficulties of such a system have been practically worked out. Mr. Andrews' system, it is true, is too expensive for "these United States," and could only be worked in a country where there is a class of customers who appreciate, and are willing to pay for, the best work that can be done. Judging from the cut and Mr. Kintner's reference to "removable covers" his system will have the advantage over the Andrews' system of cheapness with a proper degree of nastiness to suit the palate of those who have done so much to bring electric lighting into disrepute with the underwriters.

The idea of magnetically locking the brushes of a dynamo against interference while in operation, might at first thought be believed to belong to Mr. Ferranti. However, it must be admitted that Mr. Ferranti never thought of so locking the exposed electric conducting parts of a low tension dynamo, the only kind in use in "buildings supplied with electric light plants." Mr. Ferranti's absorption in 10,000 volt dynamos would account for his failure to apply the idea to dynamos from which a baby could take shocks without discomfort.

Seriously, electricity is no longer in its infancy, if some electricians are. We have had too much of "taking the other fellow's dynamo, and painting it red" and taking the other fellow's hard-earned and well-worked out practice and "revising" it into a "system"—on paper.

CHARLES WIRT.

CHICAGO, ILL.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED OCTOBER 31, 1893.

Alarms and Signals:—

Electric Protective System, F. G. Storey, Cambridge, Mass.; E. R. Andrews and J. P. Cushing, Boston, Mass., and H. F. Eaton, Quincy, Mass., 507,569. Filed June 24, 1893.

A protective system especially adapted to safe deposit vaults, banks, etc.

Electric Signal Apparatus. J. C. A. Xiezopolski and C. Bode, Milwaukee, Wis., 507,869. Filed June 29, 1893.

Automatic electric burglar or fire alarm.

Electric Train and Switch Signal Device, G. E. Miller, Saugus, Mass., 507,918. Filed May 24, 1893.

An electric block signal system for steam railways.

Electric Burglar Alarm, T. S. Patty, Cooper, Iowa, 507,925. Filed Jan. 26, 1893.

Conductors, Conduits and Insulators:—

Insulating Compound, J. J. Fanning, Chicago, Ill., 507,678. Filed May 27, 1893.

Consists of plaster of paris, asbestos, dextrine and linseed oil.

Distribution:—

Electrical Transformer, W. P. Carstarphen, Jr., Denver, Col., 507,526. Filed Nov. 7, 1892.

A transformer terminating at one end in a plug fitting into a lamp socket.

Series Multiple Electric Controller, A. P. Knight, Boston, Mass., 507,547. Filed Jan. 26, 1892.

Claim 1 follows:

The combination with a constant potential circuit of an electric motor in series with a second motor on the said circuit, a separable connection for said motor and a connection around it containing a resistance.

System of Electrical Transmission of Power, C. J. Van Depoele, dec'd, Lynn, Mass., 507,945. Filed Oct. 23, 1890.

Comprises means whereby current is taken from a circuit of any available potential above that at which it is to be employed, and rising and falling current transmitted to the translating devices of the desired potential below that of the supply.

Dynamos and Motors:—

System for Operating Electric Motors, E. C. Morgan, Chicago, Ill., 507,629. Filed June 9, 1892.

A reciprocating motor designed especially for rock drills or mining machines.

Electric Motor, J. F. Kelly and C. C. Chesney, Pittsfield, Mass., 507,658. Filed Dec. 7, 1892.

Has for its object to effect by means of alternating currents the simultaneous magnetization and demagnetization of the field and armature cores respectively of a commutating motor which is required for its proper and efficient operation.

Magnetic Frame for Field Magnets, A. L. Riker, New York, 507,689. Filed July 27, 1893.

Consists of two sets of blanks one forming the pole sections and the other the core sections.

Laminated Field Magnet Frame for Dynamo-Electric Machines, A. L. Riker, New York, 507,690. Filed July 27, 1893.

Composed of three blanks constituting, when laid together without overlapping, a symmetrical figure with the core portions at one end and the pole pieces at the other.

Portable Electric Pump, C. J. Van Depoele, dec'd, Lynn, Mass., 507,946. Filed Feb. 26, 1891.

A reciprocating electric engine in which a current of rising and falling character is alternately supplied from a distant source to two sets of motor coils within which the piston is reciprocated by the movement of the field of force.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, J. A. S. Gregg, New Rochelle, N. Y., 507,708. Filed April 3, 1890.

Relates to an automatic system for the renovation and discharge of the electrolytes according to the requirements of the work being done by the battery.

Lamps and Appurtenances:—

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 507,554. Filed July 31, 1893.

An incandescent lamp in which the neck of the bulb is closed by a plug of fusible cement.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 507,555. Filed July 31, 1893.

The invention consists in an arrangement of discs whereby a fusible cement plug is prevented from becoming overheated from the filament.

Incandescent Electric Lamps, W. E. Nickerson, Cambridge, Mass., 507,556. Filed July 31, 1893.

The invention relates to employing mica discs for intercepting the radiant heat from the filament.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 507,557. Filed July 31, 1893.

The invention relates to a device for holding in place a disc intended to intercept the radiant heat from the filament.

Incandescent Electric Lamp, W. E. Nickerson, Cambridge, Mass., 507,558. Filed August 5, 1893.

The invention consists of the composition of a fusible cement plug composed of a resinous body made flexible and adhesive by fat, solid at ordinary temperatures.

Electric Arc Lamp, H. Wilbrant, Brussels, Belgium, 507,867. Filed July 6, 1893.

Employs an electromagnet and an armature acting directly upon the carbon holder without any intermediate mechanism.

Electric Arc Lamp, W. B. Luce, Brookline, Mass., 507,916. Filed Nov. 26, 1892.

Employs a friction mechanism operatively connected to the upper carbon, automatically regulating its movement.

Miscellaneous:—

Electrical Steering Gear, C. W. Ayton, New York, 507,529. Filed July 13, 1892.

Electrically Operated Machine for Molding Clay or Cement Pipes, R. Boeklen, Omaha, Neb., 507,671. Filed July 30, 1891.

Mail Box, A. Krastin, Cleveland, Ohio, 507,660. Filed Jan. 6, 1893.

Electrically Operated Piano, L. J. Zimmerman, Linden, N. J., 507,708. Filed Sept. 16, 1892.

Electrolytic Apparatus, T. Craney, Bay City, Mich., 507,886. Filed March 16, 1893.

Has for its object to make a permanent diaphragm that will produce an effective separation with a minimum of electric resistance.

Device for Demagnetising Watches, F. M. La Boiteaux, Cincinnati, Ohio, 507,912. Filed Jan. 21, 1893.

Railways and Appliances:—

Ice Scraper for Trolley Wires, W. Heston, Alliance, Ohio, 507,539. Filed Nov. 26, 1892.

A removable scraper fixed to the trolley pole and bearing upon the under side of the wire just in front of the trolley.

Electric Car Brake, J. H. McEvoy, Waterbury, Conn., 507,589. Filed Dec. 30, 1892.

An electro-mechanical brake actuated automatically by the momentum of the car, or mechanically by the motorman if desired.

Electric Railway Supply System, G. T. Woods, New York, 507,606. Filed March 2, 1893.

A street railway conduit system relating especially to the method of connecting up the circuits.

Trolley Wheel Guard, J. N. Akarman and F. Le Noir, Worcester, Mass., 507-641. Filed April 10, 1893.

Consists of two wires held by supports parallel to and below the trolley wire.

Switch for Trolley Wires, G. A. Huben, Springfield, Ohio, 507,732. Filed July 29, 1893.

Consists of a triangular plate with flanges to guide the trolley wheel from one wire to the other.

Trolley for Electric Railways, G. A. Huben, Springfield, Ohio, 507,733. Filed July 29, 1893.

Provides for the lateral displacement of the trolley.

Conduit Railway Conductor, J. W. Grantland, Philadelphia, Pa., 507,806. Filed May 17, 1892.

Claim 1 follows:

In an electric railway a hollow conductor provided with a partial covering of insulating material and means for supplying a heating medium to the conductor.

Switches and Cut-Outs:—

Electric Circuit Testing and Switching Device, M. Robinson, Newton, Mass., 507,691. Filed March 6, 1893

A switch designed especially for electric gas lighting systems.

Combined Switch and Cut-Out for Electroliers, I. Goldkind and M. Stirn and L. Stirn, New York, 507,803. Filed April 25, 1893.

Telegraphs:—

Machine Telegraphy, P. B. Delany, South Orange, N. J., 507,791. Filed May 4, 1893.

Relates especially to a form of perforating machine electrically actuated and controlled by an ordinary Morse key.

Telephones and Apparatus:—

Test and Signal Circuit and Appliance, T. Spencer, Cambridge, Mass., 507-565. Filed Nov. 19, 1892.

The invention has for its object to centralise the working batteries of sub-station telephone transmitters at the central station.

Telephone Circuit, J. S. Stone, Boston, Mass., 507,568. Filed Jan. 31, 1893.

Relates to a centralized system of current supply for telephone transmitters in which either voltaic primary or secondary batteries, dynamos or thermo-piles may be employed.

Telephone Transmitter Circuit and Apparatus, J. S. Stone, Boston, Mass., 507,694. Filed May 22, 1893.

Telephone Transmitter, J. H. Mason, Brooklyn, N. Y., 507,715. Filed June 6, 1893.

Claim 1 follows:

The telephone transmitter, comprising an aluminum film or sheet as one terminal, a second terminal spaced from the aluminum film or sheet and finely sub-divided carbon treated with paraffine wax forming an electrical communication between the terminals.

Telephone, S. D. Field, Stockbridge, Mass., 507,728. Filed June 30, 1893.

A magneto telephone provided with a plurality of diaphragms mechanically connected to an induction generator in such relation that the mechanical energy of all the diaphragms will be added together in effecting a movement of the generator. (See THE ELECTRICAL ENGINEER, Nov. 8, 1893.)

LEGAL NOTES.

EDISON LAMP LITIGATION—THE OCONTO APPEAL AT MILWAUKEE.

THE appeal of the Oconto Co. from the injunction granted by Judge Seamans under the Edison lamp patent, was heard at Milwaukee on Nov. 11, before the U. S. Circuit Court of Appeals, consisting of Judges Woods, Jenkins and Bunn. Argument was not concluded on that day, however, but was continued on Nov. 13, after the present issue of THE ELECTRICAL ENGINEER went to press.

It was agreed at the outset that each side should be limited to five hours, whereupon Mr. Herrick, of Chicago, discussed several of the legal points, in behalf of the Oconto Co. He was followed by Mr. Kenyon, of Witter & Kenyon, who sought to emphasize the importance of the evidence going to show that Goebel had used bamboo as a filament 25 years previous to Edison, and who pointed out that Edison did not discover the utility of bamboo until two months after the patent now sued under had been granted. Mr. Kenyon made the most of such details as the existence of Goebel's old bamboo shaving machine. He also showed the court that they had new evidence and affidavits and that corroboration of Goebel's story was turning up, on every hand, all the time. Mr. Kenyon also endeavored to show that the long delay in the preparation and presentation of the Goebel case was due to reasonable causes. A number of cases were cited in behalf of the Oconto Co. to prove that injunctions had been sought and denied, where the evidence of anticipation was by no means as strong as in the present case.

Mr. Kenyon had not finished his argument on Saturday afternoon when Judge Wood adjourned the court until 11 a. m. on Monday. The Edison side of the case is being conducted by Mr. R. N. Dyer.

THE EXPIRATION OF EDISON'S ENGLISH PATENT.

THE English patent of Mr. Edison on the incandescent lamp expired on Nov. 10. The view is held in certain quarters that the American patent also expires by limitation, but no attempts have yet been made, so far as we are aware, to undertake the manufacture of the Edison lamp by those who have been enjoined by the Courts. We note a great outburst of activity in England in the manufacture of incandescent lamps.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

ANOTHER FLYWHEEL GONE WRONG.

THE immense fly-wheel at the electric light works of the Peoria General Electric Company, burst recently and did considerable damage, wrecking the front part of the building and completely destroying two 50-light generators and one exciter. Portions of the wheel went through the roof and landed a block away, while other parts went into the basement of the building, tearing through immense timbers and forcing the flooring into the foundation.

The accident was probably caused, it is thought, by the slipping of the governor belt and occasioned a stoppage of only about ten minutes as the other two engines were immediately started up. The loss is estimated at from $15,000 to $20,000. No one was hurt.

HARRY S. SMITH & CO., LTD.

ON November 1, 1893, Harry S. Smith & Co., Limited, Philadelphia, completed their first year of business. It has been a year of progress and success and the members of the firm are to be congratulated. The first contract taken was for the electric light and signal system in the new Hotel Metropole, on South Broad street, Philadelphia. During the first year the company has completed many contracts for wiring residences, stores and factories, and has installed a number of isolated plants; the first of these being for the restaurant of W. W. Bache, Ninth and Locust streets, Philadelphia.

An 110 k. w. Eddy multipolar generator was recently sold to the Wm. Cramp & Sons' Ship and Engine Building Company for use with motors on crane work in their new foundry. A direct coupled plant is now being installed in the new Hotel Hanover in course of construction at Twelfth and Arch streets, Philadelphia; Eddy multipolar 50 k. w. generators and New York Safety Steam Power Company's engines being used. The company also have the contract for all electric light and bell wiring in the hotel.

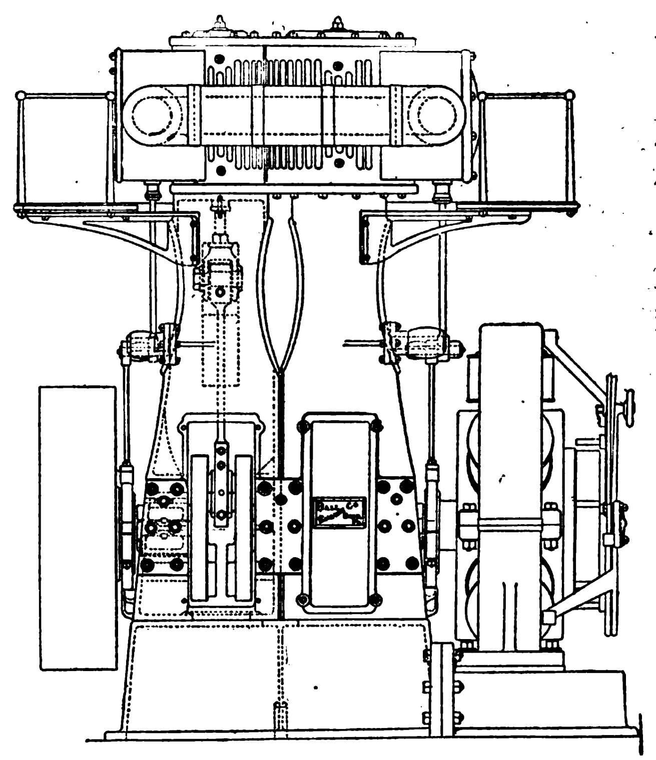
In August last, Mr. J. W. Lucas, formerly with the General Electric Company, at the Schenectady Works, was taken into full partnership and now looks after all construction work. In all construction work skilled workmen only are employed, and the company are making an enviable reputation owing to the high standard of their work.

The company have a large storeroom fully stocked with all electrical appliances and specialties and are the general agents for the Safety Insulated Wire and Cable Company of New York, a great amount of whose wire has been supplied to the Wm. Cramp & Sons' Ship and Engine Building Company for use on the new United States cruisers and Government vessels.

Recently the company have been given the general agency of the Waddell-Entz Company of New York, builders of slow speed multipolar generators and motors, and will undoubtedly do a great amount of business with direct coupled plants.

THE BALL VERTICAL CROSS COMPOUND ENGINE.

THE accompanying illustration represents a vertical engine designed by the Ball Engine Co., of Erie, Pa., and adapted especially for electric lighting and electric railway service. It will be built in various combinations, such as cross compound, triple and quadruple expansion. The view shows a 16 inch, low pressure engine; cylinder, 28 inches, stroke 16 inches, speed 240 revolutions. In the design of this engine the builders have retained all the



BALL VERTICAL CROSS COMPOUND ENGINE.

features of strength and solidity possessed by their horizontal engines, with the same degree of accessibility.

The engine being of the enclosed form has not only the advantage of cleanliness, but by its manner of construction all the parts are readily reached. For instance, the shaft boxes may be removed and the shaft taken out without the disturbance of any other part of the engine and with the greatest facility and ease. The valves are simple and durable. As originally fitted up they are absolutely steamtight, and owing to their construction continue to follow up their wear without any outside attention. The valve driving mechanism is very simple and is designed so that all necessary adjustments may be speedily and safely accomplished by attendants of average ability. Internal condensation is reduced to a minimum and compression used to its greatest point of economy. The crank shaft is a solid steel forging from end to end, of ample proportions, and the crank shaft bearings are adjustable for wear. It is claimed for the governor that it will give practically perfect regulation, with almost entire freedom from wear and unequaled quickness of action. It is economical and cleanly in the use of oil, simple and durable, and noiseless in operation.

The engine from a mechanical standpoint is well designed as to distribution of material and is thoroughly well built. The use of large and accurate tools in its construction allows the operation on each part to be originally perfect in itself. The engine is adapted for hard and constant service in the most trying situations, and it is claimed that for an equal transmission of power, either as a steady or a widely intermittent quantity, it has no superior in any form.

THE CENTRAL ELECTRIC CO.

The Central Electric Company state that they have been receiving large orders for all sizes of porcelain insulators and are making a specialty of this particular line of goods. They claim to be handling the highest grade of porcelain ware, and the numerous large orders which they have recently booked seem to confirm their statements. There have been so many cheap, shoddy insulators foisted on the market that it will no doubt be of interest to the trade to know that another vitrified and waterproof insulator can now be secured.

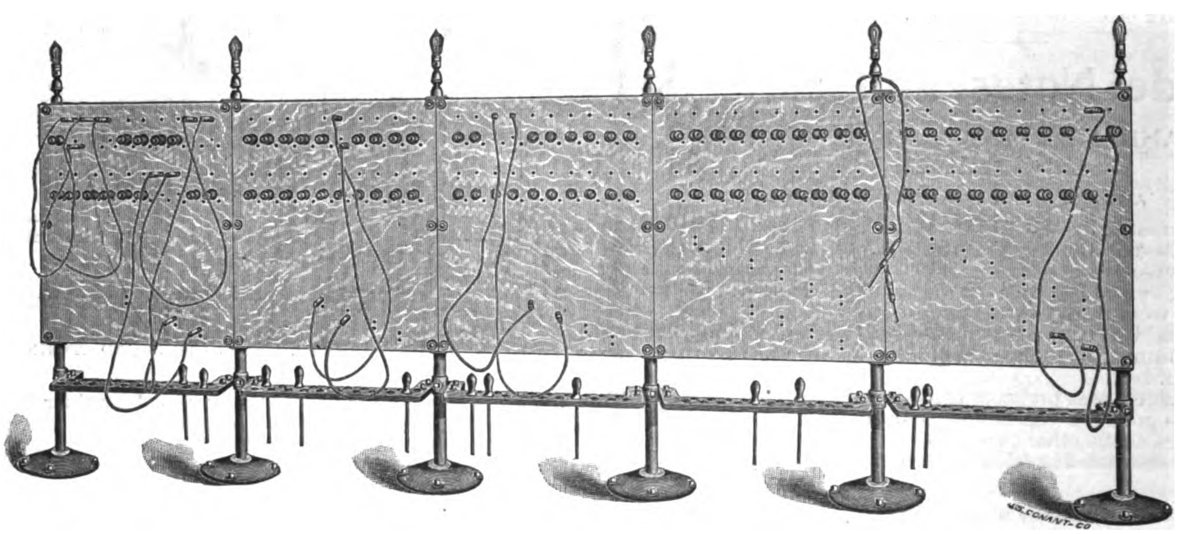
The company have also met with great success in the introduction of their key socket and among the number of flattering letters which have recently been received by them, showing the way the trade appreciates their efforts in placing on the market such a superior device, they quote the following:

"Your favor of recent date at hand together with the sockets sent for inspection. After examining the socket I would say that it seems to be up to the standard in all particulars. The contacts are good and the weight and breadth somewhat greater than other styles. In fact we rather like the looks of it and you may ship your socket in place of the one ordered."

SWITCHBOARD FOR THE NARRAGANSETT ELECTRIC LIGHTING COMPANY OF PROVIDENCE, R. I.

The accompanying illustration shows a new fifty circuit arc switchboard, which has been recently installed in the station of the Narragansett Electric Lighting Company of Providence, R. I., and which was built by the W. S. Hill Electric Company of Boston, Mass. The board is made of the best Italian marble, mounted on wrought iron standards. No metal parts in electrical circuit appear on the front of the board, and consequently there is no danger to the operator. The working parts are all fastened to the back of the board, avoiding all necessity of bolts on the front, and adding greatly to its safety and general appearance. The connections are made by long plugs, two for each circuit, and to prevent injury to the metal from arcing when the plugs are withdrawn, the opening of the circuit is made through porcelain tubes eight inches in length. The dynamo connections are shown at the lower part of the board, and are connected to bus bars running along its entire length at the back, enabling the operator to connect any dynamo to any circuit by means of a flexible cable only six feet long.

The illustration shows a circuit at each end of the board both



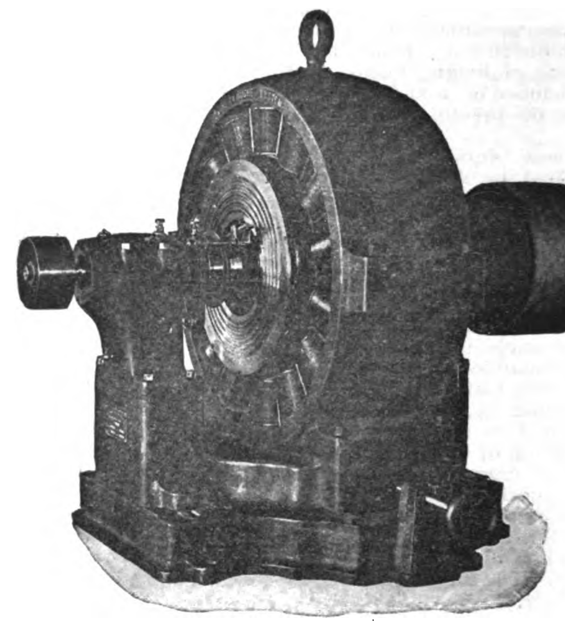
Fifty Circuit Hill Arc Switchboard for the Narragansett Electric Light Company of Providence, R. I.

connected to the same dynamo. By this means the confusion from having a great mass of loose cable is avoided, and the operator can always see at once the exact condition of his circuit. A board similar to this, for twenty-four circuits, has just been completed for the Lynn Gas and Electric Company, of Lynn, Mass., and the Hill company are at present at work on an eight panel switchboard for alternating current work with capacity for six 7000-light machines.

The W. S. Hill Electric Company are rapidly coming to the front as manufacturers of high grade switches and switchboards, and have been kept busy, even to the extent of working nights, during the past few months of general depression. Their large switches are particularly deserving of notice, and they recently shipped a single order, weighing over three and one-half tons. These switches were of various sizes, but comprised some of 1,000 and 4,000 amperes capacity, the latter being among the largest, if not the largest, ever made in this country. The company are represented in New York City by the enterprising firm of Elson & Brewster, at 122 Liberty street.

THE NEW LA ROCHE ALTERNATOR.

The accompanying illustration shows the 2,000-light La Roche alternator embodying all the most recent improvements. The electrical design of these alternators, both of the single and



New La Roche 2,000 Light Alternator.

two phase types, is such that while maintaining a practically constant potential from no load to full load, the iron losses have been reduced to a minimum, and by means of the greatly diminished air gap and close proximity of the armature coils to the magnetic circuit, the electrical efficiency has been increased. The copper on the armature is said to be probably less than that of any other alternator on the market of equal output, for by an improved method of winding and placing the armature coils, it has been found possible to entirely do away with the so-called "dead" wire on the armature. Another novel and vital feature which cannot but interest every central station engineer, is the method of connecting the armature, by which the potential between the different coils is greatly reduced below the total E. M. F. developed by the dynamo.

Mechanically, the design of the alternator is so proportioned as to render it remarkably stable and firm upon the foundation, but capable of perfect adjustment by means of heavy cast iron subbases provided with a belt-tightener. The machines are provided with large self-oiling and self-aligning bearings of the ball and socket type, well babbitted, and provided with an automatic overflow, with brass rings for securing a continuous lubrication. Another feature, the construction of the brush-holders, will prove highly advantageous where it is required to suddenly lift the

brush from the collector. Other details of construction have been perfected to meet the practical requirements of alternating current distribution, so that after a trial of six years, during which time they have undergone modifications and readjustments, the La Roche alternators embody what practical experience has undoubtedly dictated to be the best for this field of work.

The constantly growing demand for larger units in electrical work, and the success with which the La Roche Company has met in the installation of its alternating and direct current apparatus during the past year, has necessitated a very great enlargement and extension of its factory and office facilities in order to handle comfortably the increasing business. The president and general manager of the company, Mr. F. A. La Roche, so well known to the electrical fraternity, is kept very busy watching the numerous interests, for even through the extremely dull summer season the factory has been running continuously. some large orders have been taken and much prospective work has been estimated upon. Additions to the engineering force of Geo. W. Bacon, of the Wightman Electric Railway Company, and Frank R. Ford, formerly Chicago agent of the Short Electric Railway Company, have recently been made, while Geo. S. Loutey, general construction superintendent for the company, still oversees the installation and operation of the apparatus. The company is also represented by selling agencies at St. Louis, Boston, Pittsburgh, Cincinnati, Mobile, Knoxville and San Francisco, and is establishing district agencies in New York and Chicago.

The new works, consisting of a spacious six-story brick building, located on the Philadelphia & Reading Railroad, at American & Diamond Sts., Philadelphia, are well calculated to meet every requirement for the prompt handling of the large alternators and generators which are now being built, for while having added advantage of the best and most convenient shipping facilities, there has been no expense spared in equipping the factory with the most complete and modern machinery, all of which is driven directly without the intervention of intermediate shafting from the slow speed automatic La Roche motors distributed through the factory. Many special machines have also been added to the factory equipment, by means of which the entire machine work, assembling and final testing can be completed with practically no handling or moving of the heavy castings.

COPPER COMBINATION.

It is reported that there is a new combination here and in Europe to advance the price of copper.

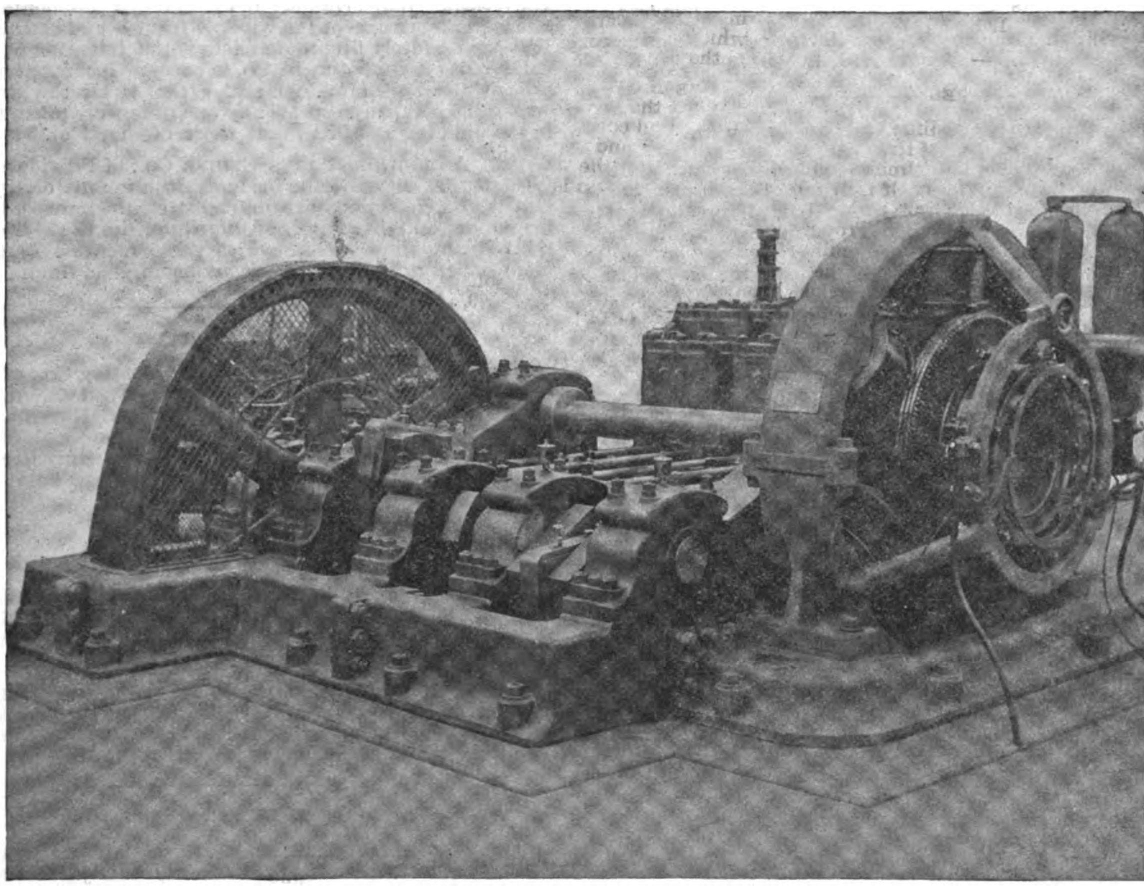
A LARGE GENERAL ELECTRIC MINE PUMP.

The application of electricity to mine service, although among the later departures in the field has already become a strong rival to steam and compressed air. This fact was nowhere so ably demonstrated as at the World's Fair in the General Electric Company's exhibit of electrical mining machinery in the Electricity Building.

The largest and most striking piece of machinery in this mining exhibit was a single reduction electric pump employed to furnish a head of water to the Pelton wheel in the three phase transmission plant.

This pump, shown in the accompanying illustration, is triplex double acting with outside packed plungers, operated by means of crossheads and connecting rods from an extra heavy forged steel crank shaft. It was designed for mine work, and has a capacity of 500 gallons per minute against 650 feet head. The plungers are of bronze, have a diameter of 5⅝ inches and an 18-inch stroke, and when operating at full capacity require 50 revolutions of the crank shaft per minute, giving a plunger speed of 150 feet. The cylinders and valve chambers are made of gun metal in order to resist the action of bad mine water. The pump is operated through a single set of gears by a General Electric 6-pole 75 kilowatt motor, making 275 revolutions per minute. This necessitates a reduction of only 5 to 1 at the gears. The design of the pump is, in many respects, novel. The arrangement of the armature shaft which is prolonged over the top of the pump, brings the motor to one side of the pump instead of in front as is usually the case. By this means a great saving in space is effected; a matter of considerable importance in mines. Hitherto, pumps of this class have usually been constructed with two sets of gears, but in this pump the necessity for one set is obviated by the slow speed of the motor, and a proportionate gain in efficiency effected.

The pump throughout is solidly, substantially and heavily constructed and may be run for long periods without cessation at its full rated capacity. An electric pump of similar capacity to this has been for some time past operating successfully in the Calumet and Hecla mine.



Large General Electric Mine Pump Exhibited at the World's Fair.

SIMS-EDISON TORPEDOES.

The new Brazilian cruiser "Britannia" has been equipped with a Sims-Edison torpedo. It is said others will be bought for the Brazilian navy.

THE METROPOLITAN ELECTRIC COMPANY OF CHICAGO.

THE following important notice to the electrical trade has just been issued by the Metropolitan Electric Company from its headquarters, 522–528 Monadnock Building, Chicago:

We beg to announce the incorporation of the Metropolitan Electric Company, with offices, salesroom, and factory as per the heading of this paper. The officers of the Metropolitan Electric Company are Wm. H. McKinlock, president, W. C. McKinlock, secretary.

The Metropolitan Electric Company has absorbed the Enterprise Electric Company, which did a general supply business. The Metropolitan Electric Company, together with this business will have the supervision of a factory and the entire output thereof, products of which will consist of H. T. Paiste's electrical specialties, comprising switches, sockets, porcelain rosettes, branch blocks, main line blocks, and general apparatus of this character. At our factory we hope to make a line of goods that will be of the latest designs and the best workmanship.

We have retained the general Western agency of the N. I. R. wire and cables, which are justly celebrated for purity of material used in their manufacture, and high quality of insulation which they possess.

We have also made arrangements with other well-known manufacturers to handle their specialties, and hope to carry a large stock of staple goods, and by courteous treatment, fair prices, and prompt shipments we trust we will merit your favors.

METROPOLITAN ELECTRIC COMPANY,
WM. H. MCKINLOCK,
President.
W. C. MCKINLOCK,
Secretary.

The Metropolitan Company reports having just secured an order of considerable importance for N. I. R. wire.

THE BERNARD COMMUTATOR PRESERVER.

USERS of carbon brushes know the extreme difficulty of getting a perfect bearing through the entire surface of the brush that is supposed to rest upon the commutator. It is almost impossible to get a brush to bear all over until it has worn itself into position by time.

The E. G. Bernard Company, of 43 Fourth street, Troy, N. Y., have brought out a compound for correcting this difficulty with copper or carbon brushes and to do away entirely with the use of oil or other greases and to enable the dynamo tender to keep his machine always in a cleanly condition. It is claimed to increase at least 50 per cent. the life of the brushes and commutator.

This preparation, it is said, if used in a proper manner, will at once build up the brush so that it will bear over its entire surface on the commutator, as there is a preparation in the compound that assimilates readily with the brush and becomes a part of it.

The company have used the preparation for some time on their own machines and feel that they can now safely recommend it to the public.

THE BUCKEYE LAMP.

WE have the following cheery item from Mr. J. H. Coke, the manager of the Buckeye Electric Company:

"The Buckeye Electric Company have reopened their factory, and find themselves overwhelmed with orders for their non-infringing "Buckeye" lamp.

"This lamp has the coiled filament, perfect vacuum, in fact *all* the strong points which in the past has so pleased the trade at large; and made the record of the "Buckeye" lamp one to be proud of.

"By the first of next month it is intended to bring the factory out-put up to 3,000 lamps per day."

THE CATARACT GENERAL ELECTRIC COMPANY.

THE CATARACT GENERAL ELECTRIC COMPANY has been incorporated for the purpose of purchasing and selling electric power, and the negotiations of contracts for the production, distribution and use of such power within the county of Monroe, and in such other places on or near the lines of railroad entering the county as may furnish a market for such power. The principal office will be in New York city, and the capital is $8,000, divided into $10 shares. The directors are: William Mertens, Thomas C. Platt, Commodore P. Vedder, Frank W. Hawley, and Charlton T. Lewis of New York city, the last three named each subscribing for 50 shares of the capital stock.

THE DUQUESNE TRACTION COMPANY.

THE DUQUESNE TRACTION COMPANY, of Pittsburgh, of which Chris L. Magee is president, has filed in the Department of Internal Affairs the annual report of its operations for the fiscal year ending June 30. During the year the company carried 6,889,970 passengers in its 55 cars, all of which are propelled by electricity. The receipts for the year were $369,640.34 and the expenses $256,004.50. The capital stock of the company is $3,000,000, and its funded and unfunded indebtedness, $1,519,000. It owns 26½ miles of road and its cars travel 3,600 miles daily.

OERLIKON ELECTRIC LAUNCHES.

THE ACCUMULATOREN-FABRIK ACTIENGESELLSCHAFT OERLIKON have issued a beautifully illustrated catalogue and price list of their electric launches and equipments. The company make a large variety of launches of different sizes and styles and these are carefully described. Photogravure illustrations are used instead of the customary half tone and the pamphlet presents a very attractive appearance. The accumulators employed are filled with the Schoop gelatinous electrolyte.

NEW ENGLAND NOTES.

THE TURNER & SEYMOUR MANUFACTURING CO., at Torrington, Conn., have decided to build their new foundry of iron and have placed the contract with The Berlin Iron Bridge Co., of East Berlin, Conn. The old foundry was burned a short time ago and the company have determined to build the foundry entirely of iron and brick; the side walls of brick, the roof of iron. The roof will consist of iron trusses and iron purlins covered with The Berlin Iron Bridge Co.'s patent anti-condensation corrugated iron. When completed, the building will contain no woodwork whatever except the window frames and casings, so that it will be absolutely fireproof and it is the intention of the Turner & Seymour Manufacturing Co. to carry no insurance on the building, as the Berlin Co., guarantee that if all the wooden flasks which the company use at any one time were piled in one place in the building and fired, that the roof would suffer no damage.

THE ARMINGTON & SIMS ENGINE CO., of Providence, R. I., inform us that they find the business situation materially improved. Orders and collections are much better, the prospect has rapidly brightened and they have had more inquiries in the last two weeks than during the whole previous three months. Such a report from such a firm is a cheering augury of good times.

NEW YORK NOTES.

THE sales of the Consolidated Car Heating Co., of Albany, N. Y., organized August, 1889, have just passed the million dollar mark, the total at the close of business, November 4, being $1,003,598.89. These figures show perhaps more clearly than any other statement, the progress which the company have made and the high esteem in which the appliances are held by railroads throughout the United States and Canada.

BALTIMORE NOTES.

THE HARRISBURG FOUNDRY & MACHINE CO. has sold through their Mr. M. E. Hershey two 300 h. p. engines exhibited at the World's Fair to the Fort Wayne Electric Co. of Baltimore, whose plant was recently destroyed by fire.

THE RIES ELECTRIC SPECIALTY CO. have moved from their old quarters to 7 South Gay street where they will have ample room for their increasing business. They are working on several new specialties which they hope to have ready in the early spring.

CANADIAN NOTES.

THE WADDELL-ENTZ COMPANY, through their Canadian agents, Messrs. John Langton & Co., of Toronto, have just installed a plant in the *Gazette* Building at Montreal, Canada. The installation comprises a 30-kilowatt incandescent dynamo and a neat slate switchboard provided with a Weston station voltmeter and a Western Electric ammeter. The dynamo is of the well-known slow speed type manufactured by the company and occupies but little floor space; the advantages of these features being brought out strikingly by two adjacent generators of the ordinary type. The plant, which is the first of its kind in Canada, is well designed and reflects much credit upon the Waddell-Entz Co., as well as upon Mr. H. B. Coho, of the engineering staff, who superintended the installation.

WESTERN NOTES.

MR. GEO. O. FAIRBANKS, for a long term of years the manager of the Westinghouse Electric and Manufacturing Company in Chicago, has connected himself with the Railway Equipment Company, particularly with a view of taking charge of the agency for the Holmes, Booth & Haydens' wire which has lately been given to that company.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

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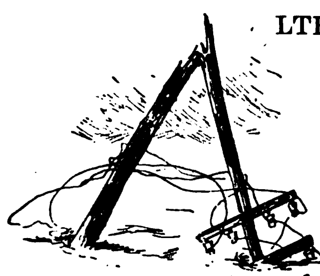
TELEPHONE AND TELEGRAPH CONSTRUCTION IN THE TROPICS.

BY

Francis R. Hart.



ALTHOUGH the same general conditions and methods of outside electrical construction prevail in all countries and in all latitudes, yet climatic influences necessarily affect minor points, and make a method of construction which in a dry and cool climate would be satisfactory very troublesome in a moist, warm country, heavily overgrown with vegetation.

The object of this paper is to point out the details of telephone and telegraph line construction which are most

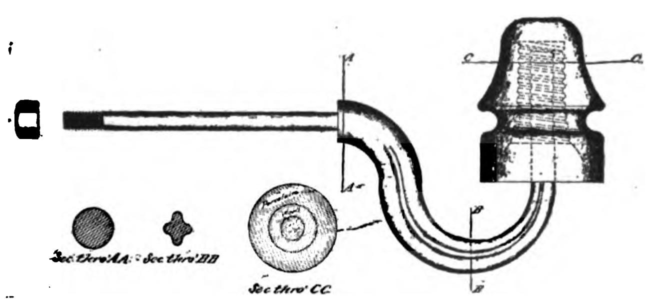
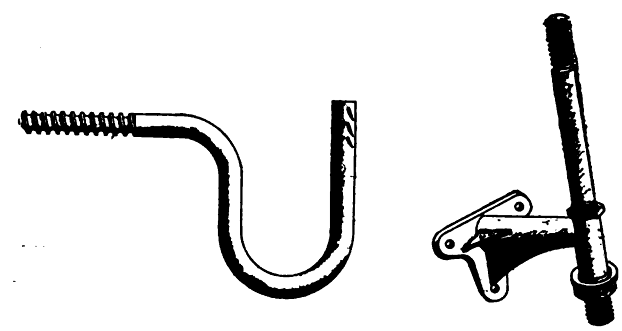


FIG. 1.

important in tropical countries, and some of which the Northern superintendent of construction would possibly be liable to overlook.

In the North, snow, ice, contraction by cold, and the proximity of other wires, are the chief sources of trouble in the construction and maintainance of lines. In the South, the first three are of course wholly missing and it is very seldom that wires are so numerous and so near as to become troublesome either by crowding or by induction. On the other hand the workman in tropical countries has difficulties to overcome which are quite different from those of the North, but which nevertheless must be carefully considered and overcome.

Throughout the greater part of the tropics for a considerable portion of the year the climate is excessively moist and warm, making the insulation of the line much more difficult. The rapidly growing vines, trees and the various and beautiful plants of the family *Orchidaceæ*, present, however, a greater difficulty than all the others. Luxuriant vegetation springs up with almost the marvellous rapidity of "Jack's" famous bean stalk. Heavy branches which are one day 10 or 12 feet above the line, when weighted down by a tropical downpour of rain rest and catch on the wires. Thick stemmed, moist vine stalks run rapidly up poles and guy wires and twist their wire-like tendrils firmly and closely



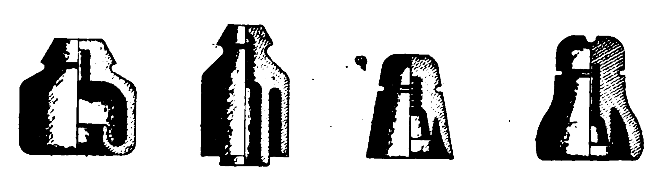
FIGS. 2 AND 3.

around the wires; and palm branches, blowing in the wind, weave their tough leaves between parallel lines. The rapidly rising rivers, the torrents which during the rains may pour through every furrow and hollow at other times dry, and the wash of gutters and culverts, make in many places almost insurmountable difficulties to permanent and economical construction.

Taking up each part of the construction separately, I shall point out what experience has shown to be satisfactory.

Wire.—Copper or bronze are by far the best and often in the end the cheapest wires, but a very satisfactory method is to use the very best galvanized iron wires for the principal parts of the lines and to put in sections of copper or bronze in the marshy and sea-coast places.

Insulators.—Porcelain insulators, although slightly more expensive, should be used in preference to glass on all telephone lines. The supports for insulators should be of a form easily and securely fastened onto the poles; nothing more unsatisfactory could be devised than the American form of wooden bracket secured by nails or spikes, it being a question of weeks rather than of months or years, before the rotting of the wood around the nails permits the bracket to be drawn off. Wooden pins set in cross-arms are equally unsubstantial. Iron brackets,

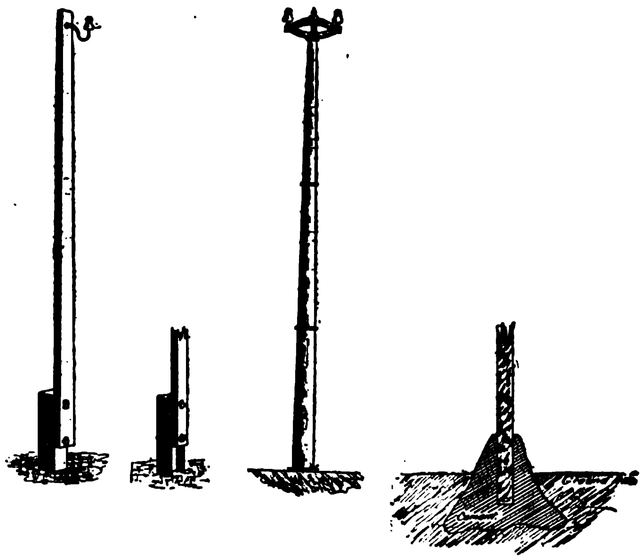


FIGS. 4, 5, 6 AND 7.

preferably galvanized, of one of the forms shown in Figs. 1, 2 and 3, are very good supports forthe insulators shown in Figs. 4, 5, 6, and 7. The bracket shown in Fig. 1 has certain advantages as it requires no screws and will hang securely to the pole even after the surrounding wood has decayed to a considerable extent. Forms of insulators for

use in heavily wooded districts will be noted under the heading "Construction."

Poles:—The woods which in the North are safe from decay for many years are practically valueless in the South. Yellow pine, thoroughly creosoted with sixteen to eighteen pounds of creosote per cubic-foot makes a fair footing to a pole, but is both expensive and inconvenient.



FIGS. 8, 9, 10 AND 11.

For wooden poles some of the native woods are found to be both cheap and lasting; the particular country and conditions must control this. If sufficiently long poles cannot be secured of native woods, a very good arrangement is to make footings of either durable native woods, as shown in Fig. 8, or of railway irons, as shown in Fig. 9, securely bolting a lighter wooden pole onto these. Iron poles have but one disadvantage, that is of large first cost. The British government use a large number of poles like that illustrated in Fig. 10. The "guy" or "brace" is equally servicable in tension or compression.

General Construction:—If pole-setting is done during the dry season, as it usually must be, the greatest care

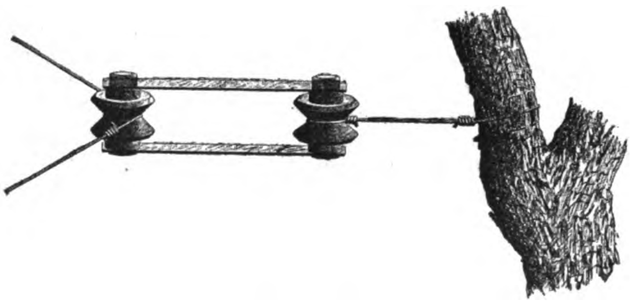


FIG. 12.

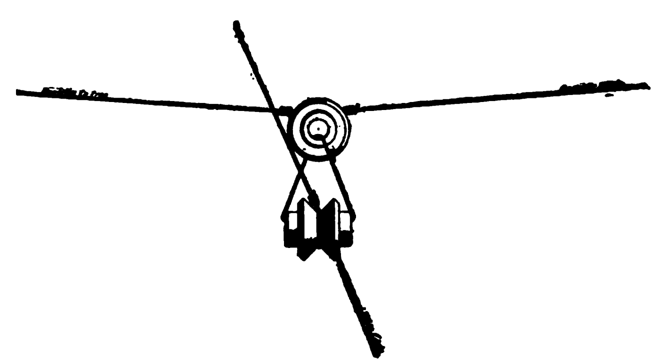


FIG. 13.

must be taken in locating and setting in such a way as to avoid future disaster from standing or running water. Braces and guys must be plentiful and so placed as to avoid, so far as possible, giving a ready support for climbing plants. Where substantial soil cannot be found, and the ordinary expedients of gravel or broken stone are an insufficient safeguard, a very good way is to make a cone-shaped base of rough cement as shown in Fig. 11; this will often suppost a pole even if its base becomes temporarily the centre of a foaming torrent.

Supports by trees must be avoided where practicable; the reasons for this which apply in the North are trebly forcible in the South where vegetable growth is many times as rapid. The sketches, Figs. 12 and 13, give some hints, however, of a very satisfactory method of crossing heavily wooded districts and jungles.

The necessity for protection from lightning varies, of course, with countries and districts and can be accomplished by the same expedients in use in the North.

For office construction and equipment the requirements vary little from the general rule. Owing to greater dampness ordinary office wire and wooden cleats are unsafe, and rubber and porcelain must be used.

Maintainence of Lines:—On nearly every telegraph and telephone in the tropics the one thing needing greatest attention is that to which it is the most difficult to get employés to attend; that is, properly "bushing" the line. It is not only necessary to trim and cut back the vegetation at regular intervals of a few weeks, but it must be done either *during* or *immediately after* heavy rains.

I have seen a half-mile section of line which, when inspected, had not one "ground," develop seventy-three contacts with branches and leaves within five hours after the inspector had reported it as clear of brush. This, of course, was the effect of a heavy rain, and must be provided for in advance by watchfulness on the part of the section lineman.

A careful regard for the details pointed out, with strictly first-class work in all other respects, together with freedom from any disturbing electrical influences, make it possible to maintain in the tropics lines which should give a service superior if anything to those of the North.

FEEDER REGULATION WITHOUT RESISTANCE.

BY W. S. BARSTOW AND C. O. MAILLOUX.

THE method of feeder regulation employed in central stations is a matter of vital importance, as it not only affects the service to the customer, but also bears directly on the dividends of the company.

As long as stations were small, not so much attention was paid to regulation. But there came a time when the novelty of the illumination no longer excused the deficiencies in service and earnings. At this juncture it was necessary to provide at once some simple, ready means of overcoming the defects in the service, even at the expense of the earnings; the equalizing resistance was the result. The development of central stations soon made it evident that methods of feeder regulation more satisfactory from the economic standpoint must be introduced.

The next step in this direction was the entire abandonment of the feeder equalizer, and the substitution of auxiliary bus bars. About four years ago the Edison Electric Illuminating Company, of Brooklyn, erected its first (Pearl street) station, making no provision for equalizers. The method of regulation contemplated was the

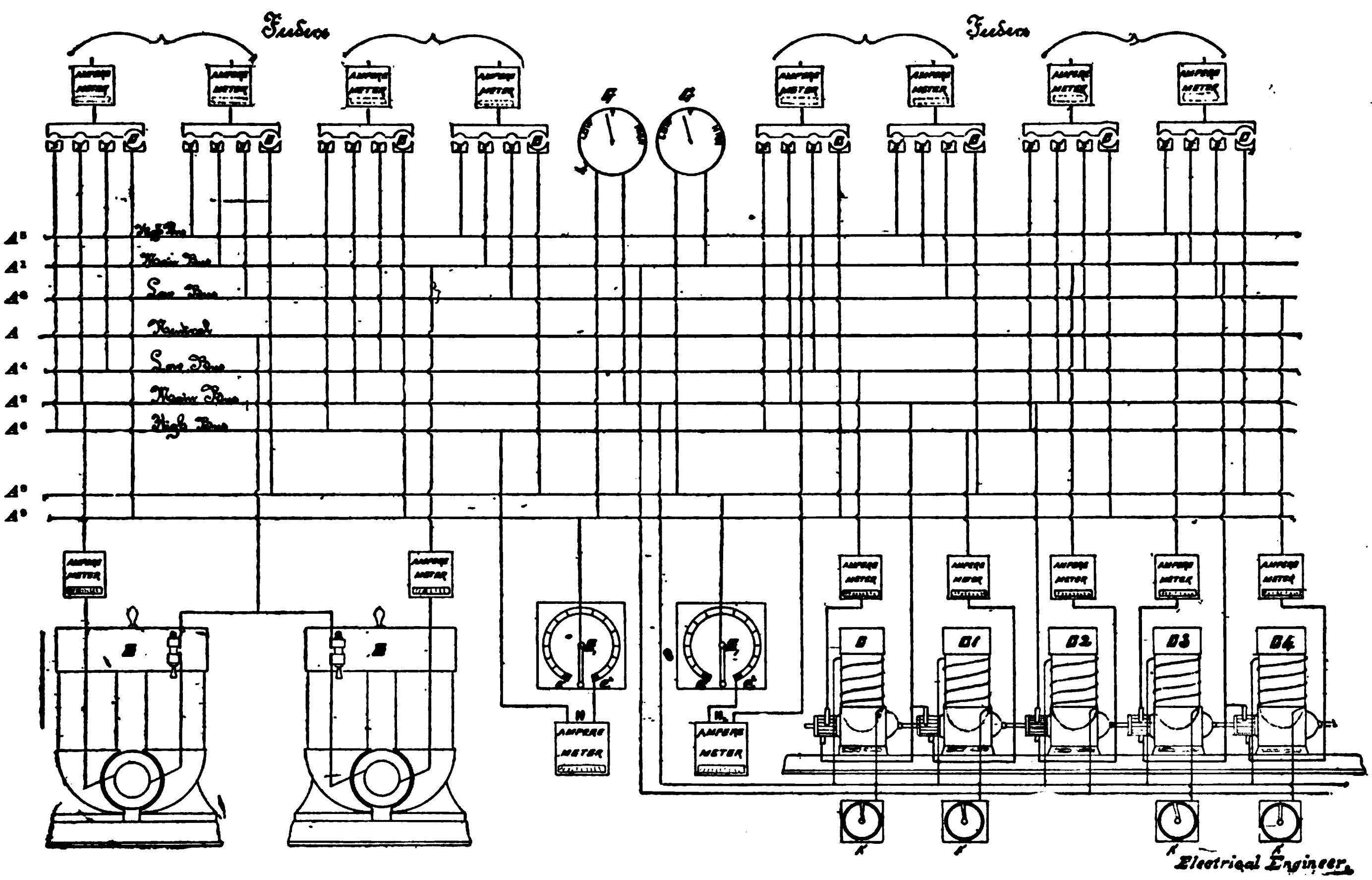
operation of the station at three different pressures for the accommodation of the different feeders. This plan succeeded admirably until a new difficulty arose, caused principally from new developments in central station units. A load was reached, for which it was necessary to operate at three pressures, and as a means of obtaining the two extra pressures, two units were operated each at a separate pressure on two different busses, each unit supplying a feeder load of only one-third of its capacity, due to distribution of load on feeders, while the balance of the station was necessarily operated at a third pressure at a heavy overload. This state of affairs not only reduced the total capacity of the station, but also introduced conditions of low economy.

Although this difficulty was temporarily adjusted, the evil was still there, and the sudden development of large direct driven multipolar generators made it more conspicuous. At this time also, attention was forced to the fact that up to the present there was no way of transferring feeders from one pressure to another without taking the load off the feeder (if only for an instant), causing a change in pressure noticeable at the lamps. In fact although the methods of operating a station at different pressures was no doubt successful it was by no means complete in practice; and without some speedy developments would have to be modified.

After considerable thought on the subject, the Brooklyn Edison Company resolved to adopt the following system, devised by the writers. The accompanying diagram shows the principal features of the system, it being understood that the details admit of some variation.

In addition to the three main bus-bars of the station, A, A^1, A^3, there are added two sets of auxiliary bus-bars, one set for a pressure lower than that of the main bus, and the other for a higher pressure. The dynamos B B are connected to the main bus-bars. The pressures on the auxiliary busses are obtained from the main busses by a set of small supplemental machines C, C^1, C^3, C^4, called "boosters," driven by a motor C^2, all five machines being coupled together. The magnetic fields of all five machines are separately excited from the main bus. The two end boosters C and C^4 have their armatures connected between the main and low auxiliary busses. These act as motors, reducing the pressure of the main busses. The other two boosters C^1, C^3, have their armatures connected between the main and high auxiliary busses. These act as generators and serve to raise the pressure of the main bus. The middle machine C^2 is an ordinary shunt wound 220 volt motor. The difference of pressure between the main and auxiliary busses is of course obtained by varying the magnetic field of the boosters.

By means of the apparatus shown at the middle of the diagram, *the feeders can be transferred readily from one bus to the other without disturbing their load in the least.* This apparatus is connected to the additional bus-bars A^8 A^9 called "transfer bus" to which the load of any feeder is shifted temporarily during the time that the load is being transferred from one bus to another; this is done by closing the connection of the feeder at C C. In the arrangement actually used this can be done only on one feeder at a time. The feeder switch has three connections, one for each pressure, as shown diagrammatically at S S S. In the form of switch actually used only one of the three connections can be made at a time, thereby preventing the possibility of coupling two busses to the same feeder. The transfer apparatus shown in the diagram consists of a simple rheostat of the dial pattern, so arranged, however, as to open circuit at either end at will. The movable arm E_1 of each rheostat is connected, as shown, to one of the "transfer" bus-bars. One end (e^2) of each rheostat is connected through an ampere meter H, H_2, with the high auxiliary bus (A^5 A^6). Special galvanometers,



Barstow and Mailloux Method of Feeder Regulation Without Resistance.

G G, known as "transfer galvanometers" are connected between the main and transfer bus.

The operation of transferring a feeder from the main to the high auxiliary bus is as follows: The rheostats E_1 being normally open, the feeder to be transferred is first connected at plugs C C with the transfer bus, thereby closing the galvanometer circuit. As the feeder is connected with the main bus, and as the other terminal of the galvanometer is also connected with the main bus, the galvanometer will remain at zero. The rheostat handle E_1 is now moved clockwise, closing circuit at e^1, whereby connection is made between the high auxiliary and main bus through the total resistance of the rheostat, the ampere meter H, H_2 giving an indication of the amount of current transferred from the high auxiliary to the main bus. By moving the handle E_1 the resistance interposed is gradually reduced, and the amount of current transferred from the high to the main bus is correspondingly increased. Usually this amount of current is increased until it is equal to the load of the feeder to be transferred.

The feeder is now disconnected from the main bus, still receiving the same current, but receiving it from the high auxiliary bus through the transfer resistance. The handle is now moved further until it reaches e^2 and all the resistance has been gradually cut out, thus gradually raising the pressure of the feeder connected to the transfer bus until (with the resistance all cut out) it receives the full pressure of the high auxiliary bus. The galvanometer G shows the gradual rise of pressure, and reaches the "high" point when the resistance is all cut out. The feeder switch is now closed on the bus, and disconnected from the transfer bus. The operation of transferring back to the main bus is the inverse of that described.

In transferring from the main to the low bus, the operation is as follows: Connect to the transfer bus; close rheostat at e^1, and move it until the load indicated at H is equal to the load of the feeder. Then open the feeder switch, leaving the feeder connected to the transfer bus; then move the handle E_1 back toward e^1, until the galvanometer G indicates that the transfer bus is at the same pressure as the low auxiliary bus; then close the feeder switch on the low bus; then move the rheostat handle back, opening the circuit at e^1; then disconnect the transfer bus from the feeder.

Instead of a single transfer rheostat, connected to the high auxiliary bus, it may be preferable in some cases to employ two smaller rheostats in place of each. In this case one would be permanently connected, as now, to the high auxiliary bus, but would serve only for transferring feeders between the high and main busses. The second rheostat would be permanently connected to the main bus, and would serve only for transferring feeders between the main and low busses.

In the arrangement thus far described it has been assumed that the distinct graded station potentials are obtained from an initial source of potential by means of supplemental electromotive force generators such as electro-dynamic machines interposed in the connections and acting in series with the initial source so as to raise or lower the potential of the initial source to the requisite point or potential difference on the so-called auxiliary bus-bars.

While it would be possible to obtain the same gradation of potential by continued direct connection to the auxiliary bus-bars at all times of one or more main dynamos initially adjusted or constructed for that purpose, nevertheless in many cases this method is objectionable if it be employed under all conditions of station working, especially in larger stations where the units of generating capacity are relatively large. During those parts of the day when the load is light the combined output of current from all the bus-bars may be only sufficient to load properly one or two units, whereas, owing to the necessity of using at least one dynamo to each bus-bar to develop and maintain the requisite potential at that bus-bar, this load will be divided among several units all running at light loads. Moreover, with relatively large units, since the loss in the machinery due to friction and other causes is to a great extent independent of the load, it follows that the efficiency (or the ratio of the useful to the total energy developed), will be very small at light loads. This is particularly true of dynamos directly coupled to compound engines, wherein the engine friction when running light may absorb a large proportion of the total power developed by the engine. By the use of "boosters" or supplemental generators, counter or assisting, in the manner above described, to develop the auxiliary bus-bar potentials, the whole load can be concentrated into two units for the ordinary three wire systems, one for each side of the neutral bus-bar.

In the modification now to be described, the objections just mentioned are overcome entirely and the use of dynamos connected directly to the auxiliary bus-bars is made a feature of great utility and convenience, as well as economy in the operation of a central station. This is accomplished by employing for the auxiliary bus-bars, boosters and dynamos, together, or singly, as the circumstances may determine, and as will be explained.

Instead of making the boosters of such construction that they can carry the whole current load supplied from the auxiliary bus-bars, they are now made of smaller current capacity, such for instance, as would be equal to about three-quarters or seven-eighths of the current carrying capacity of the armature of one of the station dynamos. If several units or sizes of dynamos are used this rating of the booster capacity is made with reference to the smallest unit. Although the efficiency of these dynamos is very low at light loads, it rises toward its normal point at loads of three-quarters or seven-eighths of normal capacity. There is, it is evident, a critical capacity or load for each dynamo, at which the efficiency loss, from all sources, will balance the losses caused by the boosters, either by the heating of their resistance or the friction of their bearings. At this point it evidently makes no difference, so far as economy is concerned, whether we use a booster or a dynamo for producing the auxiliary bus-bar potential.

The booster system is arranged as in the previous figure, suitable provision being made for connecting and disconnecting the machines from the bus-bars.

In the operation of the system, so long as the load is too light to make it economical or expedient to employ separate dynamos for the auxiliary bus-bars, the auxiliary busbars receive their current from the main bus-bars, through the booster armature, in passing through which the potential is suitably raised or lowered. When the load reaches a point where the auxiliary bus-bars have to carry more load than the booster can carry, a separate dynamo is started and after being brought to the proper potential, is switched directly onto the auxiliary bus-bar, thereby relieving the booster, which may now be entirely disconnected. If the load should further increase until the separate dynamo feeding the auxiliary bus is fully loaded, the booster can again be connected so as to take part of the load, and when the load has sufficiently increased to load both the dynamo and booster, another separate dynamo can be connected to the auxiliary bus. Thus the booster serves as a means of carrying loads which could not be economically carried by the dynamos direct; and on the other hand, by thus combining the two factors, dynamo and boosters, the initial capacity and cost of both is minimized.

As will be obvious the gradations of potential of the main dynamos might be secured not by regulation but by providing dynamos whose primary capacity should be initially different; but as the differences of potential are not very great the range of adjustment of machines of the same primary or rated capacity may be depended upon to give the required differences of potential upon the busbars.

Although the term "booster," first used by Mr. Barstow,

was originally intended to designate a supplemental dynamo interposed in a feeder connection for the purpose of raising or "boosting up" the pressure in the feeder, we have found it convenient to extend its meaning to supplemental dynamos serving to lower the pressure as well. The great convenience of the term, which has already passed into general use, is our apology to the lexicographers for thus taking liberties with the verb "boost."

It may be of interest to call attention to the peculiar results obtained by coupling together the boosters which raise and those which lower the potential. The boosters which lower the pressure (between the main and the low auxiliary bus) are the same in construction as those which raise the pressure for the high auxiliary bus; the only difference being that they are connected in the reversed manner, so as to operate as motors instead of as generators. In the diagram it will be noticed that these "down" boosters are the end ones of the five machines coupled together. The "up" boosters (which act as generators) are placed between the "down" boosters and the middle machine. The latter is not a booster, but a "compensator." It sometimes works as a motor, sometimes as a dynamo. For instance, if only the "up" boosters are in circuit, the compensator operates as a motor. Its function then is to keep the boosters operating at proper speed and to supply the necessary power (derived from main bus) to run the boosters under the electrical load they have to carry which is the product of the current passing through their armatures by the difference of pressure between the main and high bus. On the other hand if only the "down" boosters are in use the middle machine acts as a generator. The speed increases slightly until the E. M. F. overbalances the main bus pressure to an extent depending upon the electrical energy that the down-boosters convert back into motive power by operating as motors. The power derived from the down boosters is taken up by the compensator and partly (less the loss in conversion) returned to the main bus, as will be readily understood by those familiar with motor dynamos.

When both the "up" and the "down" boosters are in operation, the compensator acts always so as to "make up" or "take up" the difference between the power required by the "up" boosters and that given back by the "down" boosters. Its action is entirely automatic both ways.

It may sometimes happen that the up and down boosters are exactly balanced in load. In such a case it is evident that the compensator will run as a motor, but supplies only the power necessary to overcome friction and to run the machines as if they were without load. Thus it is seen that, virtually, a given amount of energy *that would usually be wasted by dead resistance in a feeder equalizer, can, by a "down" booster be converted into motive power; and this power, spent in operating an "up" booster will raise the pressure on another feeder or set of feeders.*

It will be seen from the foregoing description that it is possible not only to equalize the feeder pressures without resistance, but also to maintain varying pressures on auxiliary busses, and to transfer the feeders from one pressure to the other without causing the slightest disturbance in pressure or load either at the station or in the distributing system. Instead of three, four or more auxiliary pressures can be used with this system, which is an advantage of some importance in stations supplying large areas, where the maximum load is of short duration, as is generally the case.

It is scarcely necessary to analyze in detail the advantages of the system from the standpoint of station economy, as it will be readily seen that with such a system the station machinery can at all times be operated at maximum capacity and efficiency. The experience had with this system in the Brooklyn station has demonstrated its success beyond a doubt, and will doubtless lead to its adoption in other stations.

ELECTRICAL CANAL BOAT PROPULSION ON THE ERIE CANAL.

BY

Jno. Dennis, Jr.

THE first practical test of electricity for the propulsion of boats on the canals is now history, and the event will long be remembered by those who witnessed it, in the eager and nipping November air of last Saturday morning, at Brighton, a few miles to the eastward of Rochester.

By an act of the last Legislature, the sum of $10,000 or as much of that sum as should be necessary, was appropriated to carry into effect Governor Flower's recommendations regarding the investigation of electricity as a motive power on the canals. Parties interested were invited to make experiments, under the supervision of the superintendent of public works. A number signified their intention to participate, but only one plan, that jointly of the Westinghouse Company of Pittsburgh and the Niagara Power Company of Niagara Falls, materialized, and it was the Westinghouse method which was tested on Saturday last.

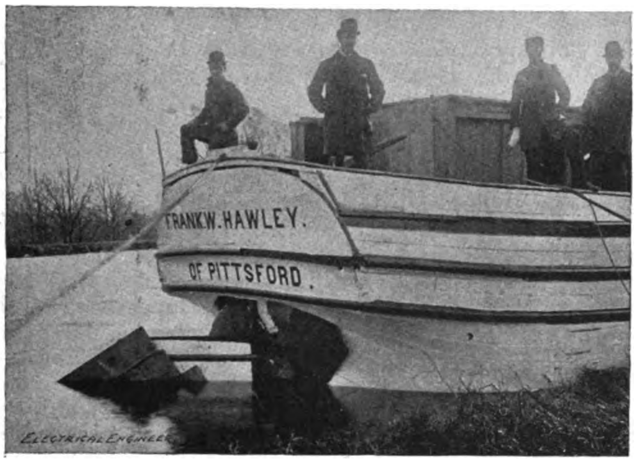
On Monday, November 13th, a party of employés of the

THE ELECTRICAL CANAL BOAT, "FRANK W. HAWLEY."

Rochester Electric Railway Company, under the immediate supervision of Electrician Elias Chessrown, representing the Westinghouse company, and Frank W. Hawley, representing the power company, began stringing a trolley wire in position, for a distance of about one mile, between locks 63 and 65, just east of the village of Brighton. After getting the span wires in position the construction party started to run out the trolley wire, preparatory to further construction, and being overtaken by darkness, were compelled to suspend operations for the night. The wires were not quite high enough to clear light boats, and one of these boats during the night fouled the trolley wire. The boatmen and scow crews, with poor judgment, cut both lines of trolley wire at three different points, in order to clear the boat. This delayed the progress of construction for nearly one day. In addition, the difficulty of handling the scows in a stiff wind, which was almost a blizzard, made satisfactory construction work a matter of considerable difficulty.

By energetic work, however, the line was ready for work by 7.30 o'clock on Friday evening, and the current from the power house of the Rochester Electric railway was turned on. In the meantime the full-sized steam canal boat F. W. Hawley, which had been re-christened in honor

of the representative of the Niagara Power Company, had been fitted and put in order for the test at the weighlock at Rochester, and was towed to Brighton, ready for the experiment. The boat started for its preliminary test at 8.30 o'clock Friday evening. It moved off readily on the first trial, and made the private run without incident. The



PROPELLER OF THE "FRANK W. HAWLEY."

Hawley returned to the starting point and was ready for the official test on the morrow.

The overhead construction consists of two parallel lines of No. 0 copper trolley wire, strung five feet apart, about one-third of the distance across the canal from the bank or heel path. The positive wire was connected with the feeder wire on the Rochester Electric Railway and the negative with the rail of the Park avenue street railway track, on which there is no supplementary ground wire. In fact the overhead construction was essentially the same as that for a double track street railway, where double trolley lines are used. In this experiment dependence was placed on the railway track for the return, and but one trolley was used. For Saturday's test ordinary street railway trolleys were used, but of course this form is not an ultimate type, and it will be superseded in practical work by an especially designed overrunning trolley, so constructed as to permit the boat to move in any part of the prism, while the trolley will follow the wire constantly.

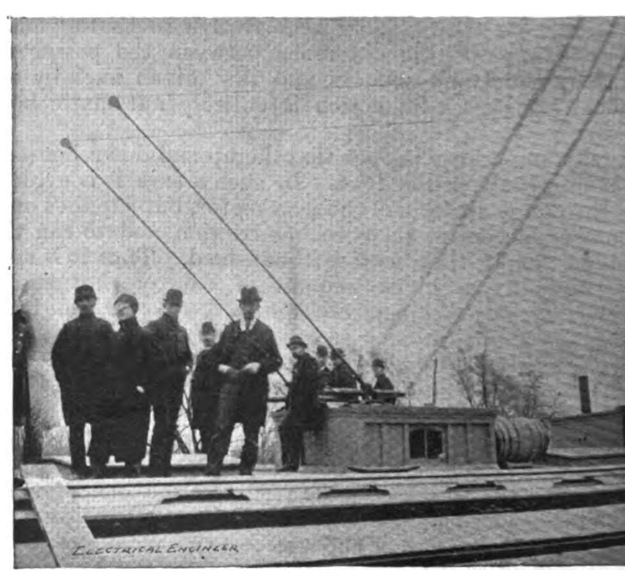
The boat used was an ordinary steam canal boat, with a propeller of the antiquated dish-pan type, not one-third of the surface of which, apparently, is active in propelling the boat. In preparing the Hawley for the test, the Westinghouse engineers simply removed the boiler and engine and replaced them with two 25 h. p. Westinghouse street railway motors, of standard type. The motors were connected directly to the propellor shaft. The connection was made by simply taking out the bolts of the coupling which held the engine shaft, and making the coupling to the motor shaft instead of to the engine shaft. It will thus be seen that the boat was, in all essential features a street car on water.

For Saturday's official test the Rochester Electric Railway Company undertook to supply 500 volts, and the apparatus was designed to do its work under these conditions. Owing, however, to the fact that the return depends for its integrity upon the fish-plates of the old Park avenue street railway track, the electrical construction of which is not yet completed, and the additional and important fact that the crowds which poured out to Brighton to witness the test necessitated adding largely to the number of cars, the actual voltage during the official test was reduced from 200 to 250, with a current of 60 amperes, making about 20 electrical horse power.

It was under these power and mechanical conditions, and in the teeth of a stiff wind that the Westinghouse and Niagara Power people undertook the first practical test in electrical canal boat propulsion, with a boat with a hold full of sand for ballast and a deck absolutely black with people. During the official test the shaft made about 60 revolutions per minute, and the speed of the boat approximated four miles an hour against the current and the wind. The extremely difficult curves, the lock and the bridges, furnished typical conditions in canal work, and were taken without difficulty, and the test, in all respects, was very satisfactory to the canal officials and the eminent electricians who watched it with intense interest.

Before leaving the matter of power, it is perhaps pertinent to call attention to the fact which is of course patent, that the electric energy furnished on Saturday was, to say the least, very moderate, when the conditions of the test are considered. The motors being first run in series, then, by means of the ordinary Westinghouse street car controller, placed in parallel, taking the full potential of the line, it will be readily seen that the minimum energy does not represent extraordinary mule power. In case, as is generally understood, the power at Niagara Falls should be utilized, the Tesla multiphase system of transmission will be adopted, by which the current will go out at a very high potential, to transformers placed at convenient points along the canal, these transformers reducing the potential sufficiently for practical working purposes. In actual practice there will be one complete circuit for east bound boats, and another complete circuit for west bound boats; similar in all respects to the double trolley for double track street railways.

It is almost needless to say that the first official test of the attempt to banish mule power from the tow path, and utilize the carrying capacity of the canals to the utmost, attracted a large crowd. Of course Governor Flower was present to throw the controller lever for the official test, steer the craft around the sharp curves and rejoice in the success of the first experiment which originated in his suggestion .While the boat was in lock 65 on the return trip, the governor made a happy little speech, and congratulated the officials and the electricians. The total cost of the experiment was about $5,000, of which amount the state will pay one-third from the appropriation for the purpose.



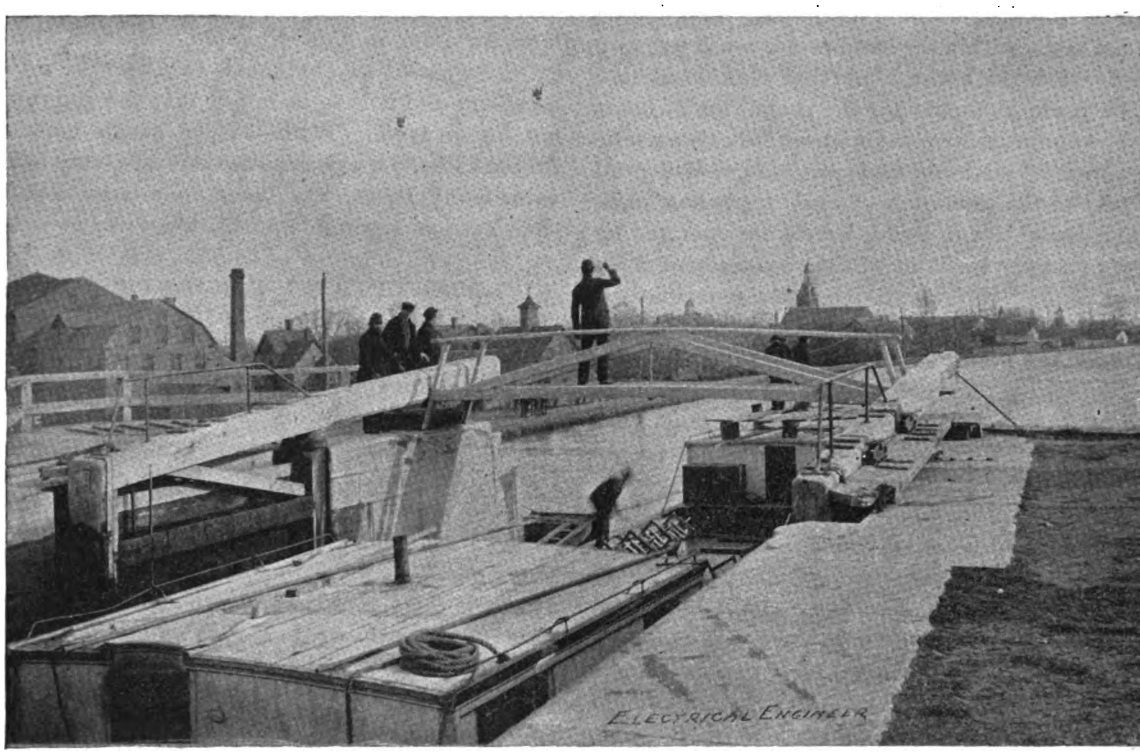
DECK OF THE "FRANK W. HAWLEY." SHOWING THE TWO TROLLEY POLES.

Electrician Chessrown had charge of the test on behalf of the Westinghouse people, and City Electrician of Rochester, Charles R. Barnes, acted as state electrician, and made

the readings of the instruments. Mr. F. W. Hawley represented the Niagara Falls people, and nearly all the canal officials were present. The New York and Buffalo produce exchanges were also represented.

The eminent electrician, Nikola Tesla, came up from New York and George Westinghouse, Jr., and other officers of the Westinghouse Company were present and witnessed the result of the test with evident satisfaction. Other prominent people, besides those who have already been mentioned were: Bishop McQuaid, of Rochester; Brayton Ives, president Western National Bank; Evan Thomas; Vice-President Alfred Romer, of the New York Produce Exchange; G. W. Balch, chairman of the canal committee of the New York Produce Exchange; Coleman Sellers, president of the Niagara Power Company; A. R. Bannister; Congressman John VanVoorhis; Senator Parsons; Assemblyman J. M. E. O'Grady; John N. Beckley, president of the Rochester Electric Railway Company; Electrician Green, of the Rochester Electric Railway Company; John Olmstead, of the Citizens Gas and Electric Company; J. Lee Judson, president of the Rochester Gas and Electric Company; Harry C. Brewster, Charles P. Ford, Max Brickner, J. G. Cutler, Eugene T. Curtis, James W. Whitney and other members of the Rochester Chamber of Commerce; Superintendent of Works Hannan; Superintendent McDonough; State Engineer Schenck; Deputy State Engineer Johnson; State Engineer-elect Campbell W. Adams; Special Agent Halligan and many canal officials.

Of the practical results of Saturday's experiment it is perhaps too early to speak with confidence. Certain it is that the Westinghouse and Niagara Power people, with a plant which was, with the exception of the superb overhead construction, professedly a makeshift, and with an electromotive force which seems almost ridiculous, in comparison with the work to be done, made a success which warranted Governor Flower in making his congratulatory address and which elicited strong expressions of satisfaction from the many professional electricians who witnessed it. That it opens the way to ultimate success in electrical canal boat propulsion, was the universal verdict. Obstacles incident to low bridges, locks, difficult curves and unfavorable atmospheric conditions, were overcome to a degree which was surprising, considering the low power, the crudity of the apparatus and the extremely heavy load carried by the experimental boat. A prediction that the Westinghouse people, encouraged by this crucial experiment, will provide apparatus for solving the problem of practical electrical canal boat propulsion satisfactorily, would seem to be fully warranted.



The Electrical Canal Boat "Frank W. Hawley" Passing Through a Lock on the Erie Canal near Rochester, N. Y.

TRANSACTIONS OF THE ELECTRICAL CONGRESS.

Inasmuch as the International Electrical Congress, held in Chicago, made no provision for the publication of its transactions, it has been proposed that the American Institute of Electrical Engineers undertake the publication. A Committee, with power, was appointed at the meeting of the Institute's Council, November 15, and it is understood that Committee has met and concluded to commit the Institute to the publication of the proceedings of the Congress, including papers and discussions, provided a sufficient number of subscribers can be obtained to guarantee the cost of the work. A circular of the subject will probably be issued by the Institute within the next week. It is obvious that a printed record of the work of the Congress, in a convenient volume, will prove very desirable to electricians throughout the world. The work will be undertaken with the co-operation of the Permanent Secretary and Chairman of Committee on Publication of the Congress, Professor Francis B. Crocker.

TRACTION AT BORDEAUX.

An electric tramway, just over three miles long, is being constructed at Bordeaux on the Thomson-Houston system. The line is almost level. Six cars will at first be put into service. The generating station contains Babcock & Wilcox boilers, and two steam engines of 150 h. p. driving four-pole compound Thomson-Houston dynamos of 100 kilowatts at 500 volts.

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ELECTRICITY ON THE ERIE CANAL.

THE enormous strides which electric transportation on land has made within the last few years has strongly impressed not a few with the hope that electric motive power may be made available for the propulsion of boats on canals. The application of steam direct for this purpose has for several reasons made but little progress, as evidenced by the fact that of the thousands of canal boats now navigating the Erie Canal, for instance, but 60 are operated by steam. How to supply each one of the thousands of these vessels, if need be, with its own motive power economically, is a question involving problems of no small importance technically, and from the standpoint of state, as well as national conditions. The Erie Canal has always been the great regulator of freight rates in the State of New York and annually saves to the inhabitants of New York city alone hundreds of thousands of dollars—the difference between the freight rates by the canal and those by railroad. Anything, therefore, which can increase the usefulness or carrying capacity of the canals deserves the fullest encouragement. Recognizing this fact the New York State Legislature appropriated $10,000 for the purpose of carrying out experiments looking to the application of electricity in the propulsion of canal boats on the Erie Canal, and on another page will be found a description of the first trials of the new method. When we consider that the average speed of canal boats with mules barely exceeds 2 miles per hour and that the whole freight carried on the New York State canals now approximates close on to 5,000,000 tons per annum, it will be apparent that the saving of but a fraction of a dollar per ton mounts up to a very large sum. It is not to be expected that in a preliminary trial of this kind every detail of a system destined eventually to attain enormous proportions could be worked out satisfactorily; and since it must have been evident to every engineer that a screw propeller could be driven as well by an electric motor as by a steam engine, we take it that the main object of the tests just made was to afford the ocular demonstration so often and perhaps justly required by the larger body of laymen interested in canal traffic. The employment of the double trolley system used in the tests, for instance, will scarcely, we think, be found to fulfill all the requirements of actual practice. It is here resorted to evidently as a makeshift to avoid the use of a ground plate, the life of which, with the electrolysing continuous current, would prove to be but very short. With the long stretches which will have to be served with current, whether from central power stations situated at Niagara, or distributed along the line, there seems every likelihood of the alternating current best fulfilling the conditions of practical work. Its employment will at once admit of running at approved high potentials for the feeders and will also obviate all trouble with ground plates. While we are very sanguine that a practical and economical system of electric canal propulsion will be eventually evolved, we must not lose sight of the fact, that in order to obtain greater speeds on our canals than is attained at present, these waterways must be deepened. With a depth of seven feet in the Erie Canal, for example, and boats drawing 6 feet of water, the well-known resistance encountered by vessels in shallow water comes into play, and if to this be added the geometrical increase in power required for increased speed the problem becomes a serious one, so far at least as speed is concerned. Before we can hope for much in this direction, therefore, the long advocated deepening of the canals to 9 feet would seem to be necessary and it is to be hoped that this improvement may not be delayed. With deeper canals and electrically driven boats, our existing canal systems may be increased in value many times, and open up a large field of work for the electrical engineer and manufacturer as well.

"LOCAL OPTION" IN SCIENTIFIC MEETINGS.

THE American Institute of Electrical Engineers has just taken favorable action on the proposal to hold local meetings for the reading and discussion of papers wherever there are enough members of the Institute to make it worth while. The subject has been brought up several times lately by members in various parts of the country, who wish to see such a plan tried; and by the adoption of a report from a special committee, the Institute now gives these members a full opportunity to show how active and urgent is the desire they have voiced. It is provided that wherever 20 members in any stated locality shall want such meetings, they shall be supplied, through the intervention of a local honorary secretary, with copies of the papers to be read in New York at the Institute meeting proper; and thus they will be in closest touch with the active scientific work of the Institute and enjoy that which is after all one of the choicest privileges of membership—actual participation in the proceedings and discussions. At present there are, we believe, three places above the 20 member limit—Chicago, Boston and Lynn; others closely approach it. It will be interesting to see how soon and how many of these places take up the plan and make it effective. The report of the Committee, which we print, is a wise one. It is "local option" in the best form, allowing plenty of freedom for unimportant local variation of practice but standing firmly by the principle of essential management by a strong, central, national body. The Institute, still less than ten years old, has already about 750 members. This plan, by creating nuclei to take interest and share in its work, may do much to increase its membership and enlarge its sphere of influence and usefulness. We have no doubt that kindred societies, affected by much the same problems of growth and scattered membership, will watch with interest the trial of the plan and adopt it, too, should it prove in any degree successful.

WORLD'S FAIR DEPARTMENT.

AUTOMATIC SWITCHES FOR CONTROLLING DISTANT LAMPS.

Among the variety of smaller electrical apparatus exhibited in Electricity Building at the World's Fair, were

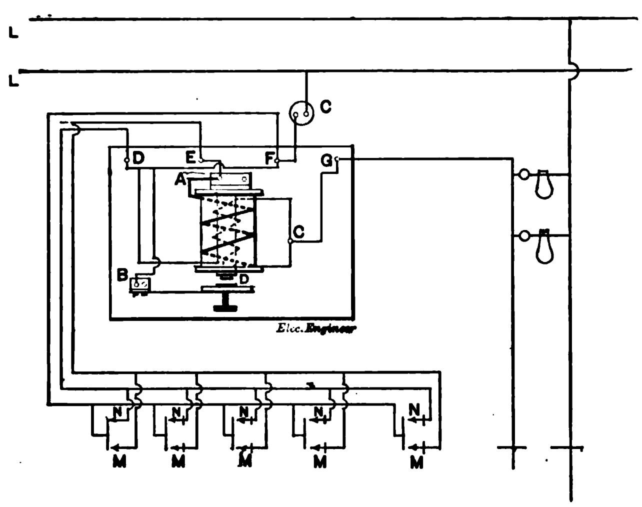


Fig. 1.

a number of electric interrupters, or automatic switches, exhibited by M. L. Vialet Chabrand, which we understand are employed by a number of steamship companies, as well as in numerous private installations in France. These switches admit of the lighting or extinguishing of a lamp or lamps situated at any desired distance by means of simple push buttons. The facility thus offered for lighting and

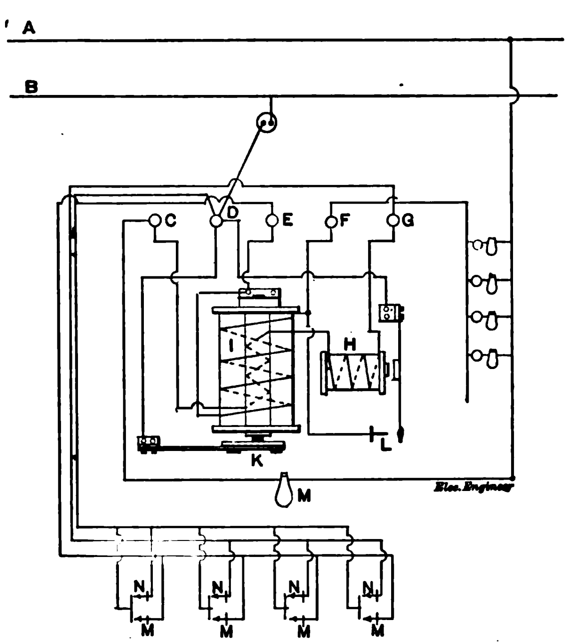


Fig. 2.

extinguishing makes it possible to economize very greatly in the amount of current consumed because it makes it convenient to extinguish the light when quitting the room for only a few moments at a time. The apparatus is so constructed that it is possible to light and extinguish lamps from as many points as one desires. Each installation comprises first, a switch, the type of which is determined by the number of lamps to be controlled, and secondly, any desired number of pushes, each enclosing two buttons similar to the ordinary bell push.

The apparatus of the first type is constructed to control one or two lamps of 10 c. p., the push buttons being placed a short distance from the automatic switch. The latter consists essentially of an electromagnet with two windings. A and B, Fig. 1 are the current leads; it will be seen by following the circuits that if any of the buttons M is pushed the current will be sent into the exterior winding of the electromagnet and thence into the lamps. The electromagnet will attract its armature and close the contact B, which closes directly the circuit to the lamps through the core of the electromagnet and the

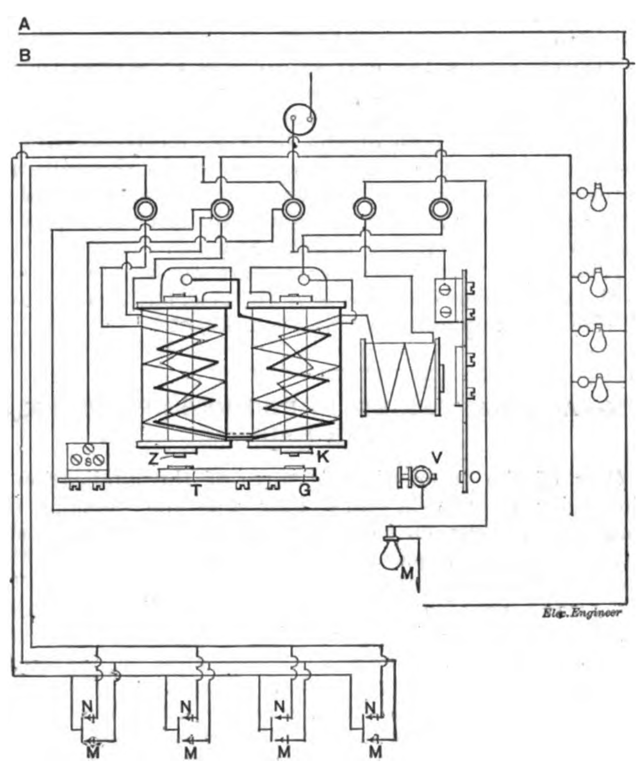


Fig. 3.

exterior winding. Owing to this combination the armature remains attracted and the lamps remain lighted when the button M is released from pressure. To extinguish the lamps it suffices to press one of the buttons N, the effect of which is to establish a shunt through the interior winding, which acts magnetically in a direction contrary to that of the exterior winding. The arrangement is such that these two magnetizations neutralize each other and the armature falls away, breaking the circuit of the lamps, which are extinguished as soon as the button N, is released.

The resistance of the shunt employed for extinguishing includes the external circuit going to the push buttons and this prevents making the distance indefinite; for, if the distance becomes too great the shunt current will not have enough strength and the electromagnet can not release the armature. In order to obviate this difficulty M. Vialet Chabrand employs another device, shown diagrammatically

in Fig. 2. The second electromagnet H is in series with the interior winding of the electromagnet I which acts as a relay. When lighting, the operation of the apparatus is exactly like that of the one previously described, but if any one of the buttons N is pressed, the electromagnet H attracts its armature and establishes the contact L, the effect of which is to establish a shunt of almost no resistance between the two terminals D and F. The current in the external winding is then cut down to almost nothing. In the meantime the shunt current in the interior winding demagnetizes the core which releases its armature.

The electromagnet H, thus acts like an interior button N, that is to say, independently of the distance of the original buttons N. A lamp M in series with the extinguishing winding merely acts as a resistance to diminish the intensity of the extinguishing current. With this apparatus from five to ten 10 c. p. lamps can be operated from a single push button.

In the third type of apparatus by which from one to ten lamps can be controlled, the principal electromagnet carries three windings, the interior for extinguishing, the exterior for lighting, and the third of heavy wire, the function of which will be explained presently. When the button M, Fig. 3, is pressed, the current passes into the external winding and thence goes to the lamps, which light up. The electromagnet attracts its armature and establishes the contacts G K and T Z. The former acts, as in the case of the first two types to maintain current in the lighting circuit, whereas the second allows the current to pass by way of the left hand core, the screw V and the heavy winding to the lamps as well. It follows then that at the moment that the armature touches the core of the lighting electromagnet, the resistance which the current encounters in the apparatus before arriving at the lamps is greatly reduced and the latter acts at the regular voltage of the circuits. The extinguishing of the lamps is done as usual.

It is evident that these apparatus are applicable not only to the controlling of lamps at a distance, but also to that of all electrical apparatus, such as motors, etc.

STORAGE BATTERIES IN PHONOGRAPH WORK AT THE FAIR.

One of the interesting features of the application of electricity at the World's Fair was the demand that sprang up for current to operate temporary devices, installations or even apparatus in use throughout the Fair. Storage batteries were specially popular. If "floats" in the ground parades carried incandescent lights, batteries by the ton were called for. If luminous fountains were set running in New York State Building on Manhattan Day, the storage battery did the work. If some little model were to operate daily, a motor and a storage battery were put in. Perhaps the most interesting and practical demonstration of this nature was seen in the northeast corner of Electricity Building, where a circle of no fewer than 28 phonographs, as busy as a singing school, attracted crowds of delighted auditors the long day through. All of these phonographs received power for their motors from the batteries of the Union Electric Co., of New York, whose exhibit, immediately north of the circle, has already been described in The Electrical Engineer.[1] The machines were divided into three groups each group receiving current from two 200 ampere hour cells. Occasionally, on heavy days, three cells were thrown in series on a group. Power was first furnished to charge the batteries on June 7, and from that date until Oct. 27 (the day notes were taken by the writer), they had never failed to deliver all the current required.

As an example of the work done by the batteries,—as well as of the income earned by the phonographs—it may be mentioned that for July 4, over 2,000 nickels were collected from the circle; while on Oct. 9 (Chicago Day), no fewer than 3,464 people heard the phonographs at the same place. The total number of nickels collected from this single set of 28 phonographs to the date named reached no less a figure than 179,169.

Not far from the circle stood one of the beautiful exhibits of Queen & Co., and the same batteries furnished current to Mr. Pike and his assistants for testing instruments, etc. The E. S. Greeley & Co. also drew current from two cells to operate their fine exhibit of telegraph instruments, including the "Victor" key.

These cells, along with the 1,000-ampere hour cells were charged from a Riker motor generator, which delivered current to the batteries at any pressure from 20 to 80 volts, the regulation being controlled by a 20 k. w. Carpenter rheostat in series with the motor, and permitting the use of either the 110 or 220-volt current. It was stated to the writer that when on the 220-volt circuit, the Riker motor generator has an efficiency of 68 per cent. after deducting all losses on both sides.

1. Aug. 16, 1893.

SELF-INDUCTION AS A REMEDY FOR STATIC DISCHARGE.

BY

Mr. P. B. Delany's article under the above title touches upon a subject which I have had frequent occasion to investigate. I am of the opinion that so far as long submarine cables are concerned, there is a possibility of the Henrys helping the Faradays out of their trouble. Cromwell T. Varley seems to have early discovered the converse behavior of self-induction and the charge and discharge due to electrostatic capacity, and very intelligently turned his knowledge to account as described in his English patent of December 26, 1862, as per following abstract:

"1st. For working long submarine lines certain arrangements of induction plates with or without resistance coils, or induction coils at the transmitting end are described and shown.

"2d. Employing a test circuit formed by induction plates and resistance coils, so adjusted to each other as to produce an artificial line possessing the same amount of retardation as the cable itself.

"This invention can be applied to almost if not all of the existing telegraph apparatus, viz., it can be applied to the relay, or to the signaling instrument direct where no relay is used as is the case with the needle telegraph, Thomson's reflecting galvanometer, Dignee's ink writer.

"Another part of my invention consists in the employment of what I term a test circuit formed by induction plates and resistance coils so adjusted to each other as to produce an artificial line, possessing the same amount of retardation as the cable itself at the signaling end. In some cases, however, it may be advisable to connect the cable to the earth through an induction coil consisting of a large bundle of iron wire surrounded by a long length of fine wire as in Fig. 1, the action of which is as follows.

"On reversing the battery connections the induction plates and battery combined send a short impulse into the cable which divides one portion into the cable, the other through the induction coil to earth. At the first moment the iron of the induction coil offers resistance to the passage of the current, consequently during the first instant of time nearly the whole force of the current is applied to the cable. As the iron becomes magnetized to its maximum this opposition ceases, but the plates have become charged in the opposite direction and there is no longer any current passing from them into the cable to maintain the magnetization of the wire, the demagnetization of which induces a current in the coil and discharges the cable. In this way each impulse is followed by a short impulse in the opposite direction. By connecting the two armatures of the induction plates with a set of resistance coils

this reversal of the current is followed by a weak second reversal in the same direction as the original current.

"In Fig. 2 the induction coil is represented as wound with two wires and connected as shown."

The application of self-induction to neutralize charge effects is clearly shown in his patent No. 1,044 of April 8, 1870, which is epitomized as follows:

"Dr. Gintl and Frischen's double-speaking apparatus and a hollow helix may be connected between the receiver and the line wire, the helix having pieces of iron inserted into it to remove the difficulty arising from the inductive capacity of the line. Helix to be of No. 26 silk-covered wire 10 inches long, 1¼ inches inside diameter, 4 inches outside diameter. Small iron rods are placed in the helix."

The trouble with this device is that it only serves one end of the circuit. If the circuit be divided into any number of equal portions the charge in each portion commencing at zero at the distant end will be as the numbers 1, 3, 5, 7, 9, etc. If the circuit be divided into two portions (assuming the resistance and capacity uniformly distributed in each case) the quantity of the two charges will be as *one* to *three* respectively. In duplex working the circuit discharges at both ends simultaneously, the greater part returning to the battery station, the lesser part traveling oppositely or in direction to the distant earth and being delayed by any coil that may be inserted at that point.

Without desiring in any way to detract from the merit of the originality of Mr. Delany's remark, contained in the ENGINEER of Nov. 1, that he was the one to advocate the use of low insulation in cables, etc., I would like, also, to draw attention to a paper by Oliver Heaviside in the *Philosophical Magazine*, Vol. 8, Nos. 46 and 47, 1879, in which he enters into a very full discussion of the effect of faults on the speed of working cables, and says:

"A leakage fault in a cable, besides weakening the received currents has another effect, viz., to accelerate the rapidity of increase and decrease of the currents, or more generally the rapidity of change from one state to another, thus enabling the cable to be worked at higher speed. An artificial conductive connection of constant resistance between the conductor and sheathing of a cable, preferably at its centre, would greatly increase the working speed, however objectionable a natural leak may be."

In this country self-induction to improve automatic transmission on land wires, was tried at a very early date by Edison and others. Prescott gives the credit to George Little.[1] The use of leaks was tried as early as 1870 upon the great overland circuits of the Western Union Telegraph Company extending between Chicago and San Francisco, a total distance of about 2300 miles. The circuits

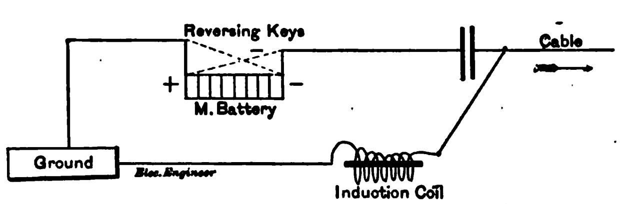


FIG. 1.

were worked Morse and in sections of about 500 miles with automatic repeaters between them. Owing to the peculiarly dry nature of the vast prairies over which some portions of the circuits worked it was found that signaling was very tedious and required long and firm contacts of the sender's key to produce signals free enough from distortion by the excessive electrostatic effects to be received at either end of the line. For hundreds of miles the poles are standing in dry sand, and frequently the great expanse of sandy plain becomes highly electrified and clouds of the charged sand particles are driven by the high winds along or across the wires, which in turn become charged by contact with the electrified sand. These myriads of charges of high voltage unite into a dynamic current towards earth at each end of the particular circuit of the section invaded and on many occasions the entire suspension of business for the time is the result.[2]

In 1883 I wrote Mr. W. B. Hibbard who had been superintendent of these circuits for several years, for information as to the value of the leaks, which consisted of high resistances placed at various convenient points along the lines to relieve the wires of their static charges. Mr. Hibbard's reply dated Rochester, N. Y., August, 1883, is as follows:

"The high resistance leaks as a remedy for induction were tried in 1870, but proved worthless."

In some cases the resistances were strips of hard wood with a conducting line of carbon made by a lead pencil between two binding posts to which the line wire and earth were respectively connected.[3] In addition to inductive troubles, both electrostatic and electromagnetic (all being iron wires), it was found that the earth plate in Crow Creek, at Cheyenne, was very high in resistance, the whole creek being well insulated in its rock channel. Mother Earth was only reached by sinking a plummet of zinc down an artesian well far below the rock stratum.

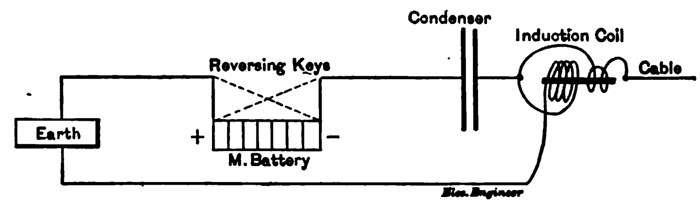


FIG. 2.

The meteorological conditions in this country have puzzled the electricians in charge of overland telegraph wires to obviate the detrimental effects of current leakage to earth. Along all railroads and in cities there is invariably a deposit from smoke of a conducting film on insulators of all kinds irrespective of the material. In cold, dry weather this film conducts very feebly as compared with its leakage in wet weather. In the country, too, the highways are lined with forest or ornamental trees whose branches, stretching over and through the wires, "muffle with verdant ringlets every string." Mr. Oliver Heaviside, the profound mathematician and physicist, is undoubtedly sound in his conclusion in the London *Electrician*, page 603, Oct. 6, 1893, viz.: "We may dismiss them and sum up that as regards land lines leakage does not seem to have a single redeeming feature."

In the case of the Wheatstone automatic system, both here and in England, electrostatic capacity is used to neutralize the effects of self-induction so far as the electromagnets in circuit are concerned.[4] In this case, however, the application has been made by inserting extra inductanceless resistance in the circuit. I have pointed out to Mr. Preece that I thought the addition of resistance to the circuit was not necessary as the resistance of the electromagnet itself could be utilized to separate the condenser plates to insure their action directly upon the relay. This seems to be demonstrated in a Hughes induction balance on which a discharge from the electromagnet alone will show a deflection of the needle, say, 40 degrees to the right. A properly adjusted condenser around inductanceless resistance (equal in ohms to the electromagnet) will deflect 40 degrees left. Then replacing the inductanceless resistance by the relay the needle will be at zero. However, in the absence of a practical test, no admission has yet been made by those competent to decide as to the merits of any proposed arrangement in practice.

The following formula, determines the capacity of the condenser to be used around inductanceless resistance in the automatic circuit, and directly around the electro-

1. Prescott, *The Electric Telegraph*, 1877 Edition, page 727.
2. *Journal* American Electrical Society, Vol. 2, page 44.
3. *Telegrapher*, Dec. 3, 1879, page 115.
4. See Preece and Sivewright, 1891 edition, page 159.

magnet, shows that the condenser is the same in either case:

Call, L, inductance of electromagnet; R, resistance; K, capacity of condenser; R', resistance between condenser plates.

The time constant of condenser and resistance arrangement is $K \times R'$; the time constant of electromagnet is $L \div R$.

So far as overhead telegraph wires are concerned it is well known that iron wires have an electromagnetic inertia which copper wires do not possess to anything like the same extent. Prof. Ayrton says the self-induction of the copper wire is much less than that of an iron wire, and it has been demonstrated by Mr. Preece that rapid signals are transmitted with much greater facility through copper than through iron. If we concede that the electrostatic capacity of a circuit is negative to its self-induction, at least at the end where the signal originates, it is only a question of which predominates to call for either electrostatic capacity or self-induction as an antidote.

For all ordinary Morse signaling on all kinds of overhead circuits self-induction of a wire is negligible. On telephone and automatic circuits, however, self-induction of the wire undoubtedly plays a part, but to what extent, even the giants are in doubt.[5]

According to Fleeming Jenkin's definition of self-induction of a straight wire, "A current flowing from A to B repels one flowing from C to D, thus:

A ⟶ B C D.

If then a current increases in A B it induces a current in front of itself in the direction in which it is flowing, and is checked in so doing."[6]

This result is due to a different cause from that in an electromagnet in which the inductance is so detrimental in all kinds of circuits, particularly automatic and telephonic. It was the assumption of a large self-induction in the wire itself that undoubtedly led a celebrated electrician in England recently to advocate high resistance wires for telephone use overhead from the fact, as demonstrated by Helmholtz's law, that to decrease the self-induction or to increase the resistance of a given circuit (not submarine) will reduce the time constant.[7]

It is well known telephones work farther and better on copper conductors of low resistance; and it appears that telephone metallic circuits formed by twin wires properly disposed do not follow the same $K R$ laws which seem to have a direct relation to the facility of talking through similar wires spread apart or through a straight circuit having capacity and resistance equal to both wires. Within the past five years in the United States the leakage of current from electric railroads has become troublesome upon quadruplex and duplex circuits, and I think is far more detrimental than any self-induction in the wires. As I understand Mr. Oliver Heaviside's advocacy of submarine cables of low insulation and low conductivity, I do not believe that he ignores in any sense the well established laws that the electrostatic capacity of any insulated wire is inversely proportional to the logarithm of $\frac{D}{d}$, when D is the diameter of the dielectric and d that of the conducting wire, and he also takes notice of the fact that there are dielectrics being introduced in underground cables for telephone use that have much lower specific inductive capacities than gutta percha which averages over $\frac{3}{10}$ microfarad per mile in the Atlantic cables.

By referring to the London *Electrician* of Oct. 17, 1890, page 688, an article will be found by Mr. Preece describing Mr. H. R. Kempe's method of arriving at a suitable cable for the London-Paris telephone circuits. It will be readily understood that were it commercially and mechanically feasible, a cable could be constructed by increasing the dielectric and the copper, each to a great thickness, so that the electrostatic capacity would become very small.

It is also obvious that were a dielectric used, with one-half the specific inductive capacity of gutta percha, the cable's electrostatic capacity would be nearly halved. So there must be a good reason why Mr. Heaviside advocates leakage and Prof. Silvanus P. Thompson proposes a plan for applying self-induction rather than doing one of the three things above named. There is no doubt that an Atlantic cable made upon a plan similar to the cable between Dover and Calais for the London–Paris telephone circuits would greatly accelerate signals. No earth connections would then be necessary, and electrostatic capacity could be greatly reduced. This plan was proposed by Werner Siemens in his English patent of Sept. 15th, 1855, as follows:

> "Object of invention is to obviate the effect of the static or residual charge on long lines of submarine or subterranean telegraphs; consists of using a set of two insulated wires placed in close proximity to each other in the same insulated coating without using the earth as part of the circuit."

Mr. W. H. Preece, whose long experience and all around good practical sense, places him in the front rank with the able college men to whose labors we are constantly and immeasurably indebted, in his inaugural before the English Institution of Electrical Engineers as recently as last January, seems to glory in the fact that the manufacture of cables has so improved in the last 20 years that a core having an insulator weighing 150 pounds per knot which had then a dielectric resistance of some 250 megohms at 75° F. can now be obtained giving 2,000 megohms. The development of the plans of both Mr. Heaviside and Prof. S. P. Thompson will be watched with keen interest. How the latter gentleman can so distribute self-induction in lumps along a cable so that each lump shall have exactly the same time constant and negative capacity as the section of cable it represents under the action of currents from either end of the cable either singly or together, as in duplex working, and that such self-induction shall rise and fall proportionately with the cable's electrostatic condition under varying E. M. F., seems a little puzzling, yet his intimate knowledge of the subject gives wings to hope.

5. See Prof. Ayrton's remarks on self-induction, *Journal*, Society Telegraph Engineers, London, page 114, Vol. 16.

6. See Jenkin's *Electricity and Magnetism*, page 74.

7. For the benefit of some of the readers of THE ELECTRICAL ENGINEER, Helmholtz's law is here given:

$$h = \frac{E}{R}\left(1 - e^{-\frac{R}{L}t}\right); \text{ or } h = \frac{E}{R}\left(1 - \frac{1}{e^{\frac{R}{L}t}}\right)$$

in which h is the strength of current after the lapse of a short time, t (seconds); E, the E. M. F. (volts); R, resistance of whole circuit (ohms); L, coefficient of self-induction (Henry's) and e the number 2.7183 the base of the Napierian logarithm; the common logarithm of which is 0.43429.

$L \div R$ = the time it requires for the current to rise to .6321 of its final value or steady flow.

STARTING MULTIPHASE MOTORS.

In starting multiphase motors, having a closed circuited secondary member, it is found that the best starting torque is obtained when the resistance of the secondary element is considerably higher than would satisfy the best running conditions. This is because the resistance of the secondary best suited to efficient running is so low that the primary rush of current flowing through it on starting from rest is large enough to exercise a demagnetizing effect on the field so great as to materially decrease the starting torque. It has therefore been not unusual to connect with the secondary element a starting resistance which later is removed from circuit. When the secondary element is the stationary part of the motor, this is very simply done by connecting properly in circuit with it an ordinary rheostat. In such case, however, collecting rings are required on the revolving member in order to supply to it the primary current. If on the other hand the secondary member is the revolving part of the motor, and a fixed non-rotating rheostat is used, sliding connections are again necessary in the circuit of the rheostat.

It is desirable to avoid the sliding contacts altogether, and this is the main object of a recent invention of Dr. Louis Bell, who makes the primary member the fixed part of the motor, and uses a starting resistance which revolves with the secondary member. The resistance is non-inductive in character, and a switch for short circuiting it is provided which also travels with the armature or revolving member, and which may be thrown while the motor is running, manually or automatically.

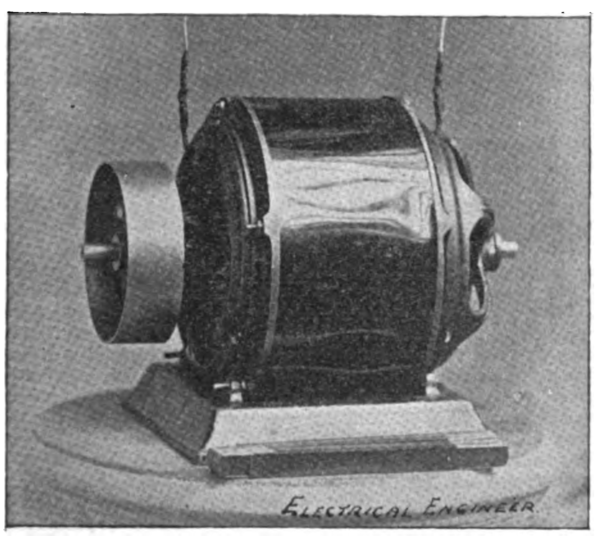
SOME RECENT DEVELOPMENTS IN ALTERNATING CURRENT MOTORS.

BY

Elias E. Ries & Gordon J. Scott

AMONG the most interesting and valuable features that characterized the work of the International Electrical Congress recently held in connection with the World's Fair at Chicago, were the remarks made by many of the distinguished delegates present upon the subject of the transmission of alternating currents and the respective merits of single and multiphase motors for power distribution. Although opinions were somewhat divided upon this latter question, it was clearly recognized that the multiphase systems at present available were merely an expedient rendered necessary by the existing state of the art, and that the advent of a simple and efficient self-starting single-phase alternating current motor would at once establish the latter as the standard type for nearly all classes of electrical power distribution.

In the course of some extended experiments made by us upon the subject recently, we have discovered and practically demonstrated a number of important facts which in many respects revolutionize the theories that electricians have heretofore held and have been accustomed to regard as essential principles in the design and construction of alternating current motors. These discoveries, which promise to inaugurate a new departure in alternating motor construction, have shown us that it is not only possible to construct self-starting non-synchronous alternating motors *of any desired power* that will run economically on single-phase circuits of any commercial frequency, such, for example, as those in common use for incandescent lighting, but that such motors will be, everything considered, *far more efficient*, both electrically and mechanically, than the best continuous current motors yet produced.



THE RIES & SCOTT ALTERNATING MOTOR.

The difficulties hitherto encountered in attempts made to construct self-starting variable speed motors intended for operation on ordinary alternating current incandescent lighting circuits, have apparently been of an insurmountable nature. With the exception of the smaller types of motors developing a fraction of a horse power, such as those used for operating small ventilating fans, where economy in the use of the current has been considered of minor importance and in which the self-induction in the energizing coils and the losses in the magnetic circuit could be kept reasonably small, all attempts to produce efficient motors to operate on a simple two-wire alternating circuit, without the employment of more or less complicated auxiliary starting or lag-changing devices, have thus far failed. Even two-phase and polyphase motors as at present constructed, although self-starting under light loads, require for their efficient operation not only a low frequency that unnecessarily increases the size of the generating, transforming and motor apparatus and which renders it in many cases unsuitable for lighting purposes (to say nothing of the greater complexity of the feeding and distributing mains which such a system involves) but, owing to the great sacrifice in electrical and mechanical efficiency when their normal speed is departed from, such motors cannot compete with direct current motors for work where a variable speed with maximum torque is requisite, as, for example, in the case of electric street railways.

Following up our researches in the alternating motor field, and with the view of producing a motor of simple construction that could be operated on any of the commercial alternating current circuits now in use with reasonable economy, we built a number of experimental motors of various types and sizes embodying some of the results of our investigations. These motors have been thoroughly tested in the factory of the Ries Electric Specialty Company, at Baltimore, Md., and the results obtained have been so successful that we are now making preparations to build them commercially.

Believing that the remarkable results we have already obtained will be of general interest at this time, we have thought it advisable to present herewith an illustration of one of the single-phase motors built and used by us in some of our experiments, together with such information concerning its operation as we are at liberty to disclose at present.

The motor illustrated has a capacity of 1 h. p., and was designed for and tested upon an ordinary 50-volt alternating current incandescent light circuit having a frequency of 138 complete cycles per second. The most noticeable feature is its extremely small size and weight for a motor of its output and efficiency. The total height of this motor, including base, is 9½ inches, the diameter of the motor proper, 9 inches; the width of motor, exclusive of end plates containing bearings, 5 inches; the total length of armature shaft, 11½ inches; while the total weight is but 35 pounds, of which only 2 pounds are copper.

Actual brake measurements were made upon this motor while it was running at various speeds on an ordinary 50-volt incandescent circuit of 138 complete cycles per second. At a speed of 2,000 revolutions per minute, taking 15 amperes of current, the motor developed 26,400 foot pounds, or .8 h. p., at an electrical efficiency of 90 per cent., the motor remaining perfectly cool after a continuous run of eight hours. With 10 amperes of current the power developed was 17,850 foot pounds, or .54 h. p., with an electrical efficiency of 93 per cent. On increasing the load on the motor and thus reducing the speed to about 1,000 revolutions with the same flow of current, the power developed was substantially the same as before, with very nearly the same efficiency. When the speed was reduced below 600 revolutions, however, the efficiency dropped appreciably, although not enough even in the case of the present high-speed machine to detract from its usefulness for continuous and effective work at speeds very much below those hitherto found practicable in direct current work.

The diameter of the driving pulley is 5 inches, yet notwithstanding this, the torque developed by the motor is so great that it starts off promptly under full load. The speed of the motor, as has been fully demonstrated by these tests, is variable within wide limits and without appreciable loss in efficiency, a result that has not heretofore been obtainable either with direct or alternating motors. Another and most valuable characteristic of one type of the motor under consideration is that with a given flow of current the torque increases, up to a certain point, as the speed decreases. This peculiarity is likewise entirely new and of the utmost importance, since it not only provides an exceedingly high starting torque, but enables the motor to develop its maximum power continuously at the highest possible efficiency and irrespective of the speed at which it may run.

It will at once be apparent that these features render this type of motor particularly applicable for all stationary and railway work where widely fluctuating loads are encountered, especially so because the principles underlying its construction are such that, unlike direct current constant-potential motors, it cannot of itself receive more than its maximum normal current under any conditions of use, and thus cannot possibly be burned out or injured by an excessive overload, or by any of the other causes which have proven to be such prolific sources of trouble in the case of continuous current motors.

Perhaps the most remarkable feature about this machine is the fact that the losses and other difficulties that have heretofore attended the use of comparatively high frequencies for alternating motor work, whether single-phase, two-phase, or polyphase, have been practically eliminated. Indeed, were it not for this discovery the results here recorded could never have been obtained. It is perhaps not too much to say that this achievement, to which we have successfully directed our strongest efforts, will contribute largely to the adoption of higher and more economical frequencies for alternating current work than those at present in vogue, or at least to the maintenance of the highest of the standard periods now in commercial use on lighting circuits, thus deservedly checking the precipitate and ill-advised tendency which is at present more or less prevalent not only abroad, where multiphase systems have for some time been exensively used, but in this country as well, to adopt as a standard for general use a current of such a low frequency as would involve not only much larger and more expensive generators, transformers and motors, but which would prove unsatisfactory and uneconomical in the highest degree for nearly every purpose to which it can be applied.

Since high frequency in alternating current apparatus is the

equivalent of high speed in direct current apparatus, in being the seat of the direct and counter electromotive forces developed, and since it is well known that by increasing the speed of a direct current armature the output of the machine for a given amount of iron and copper is very much increased, it follows that the higher the frequency that can be used, the better the results obtained from an alternating current motor of a given size and weight. While there are serious mechanical limitations to higher armature speeds than those now in use, there are, so far as the motor is concerned, no longer any restrictions to the use of higher frequencies, since the self-induction and hysteresis, which in all previous types of alternating current motors have been the principal sources of loss, are now for the first time utilized in our motor, and turned to practical account, as shown by the fact that the motor runs perfectly cool despite the small quantity of iron and copper in the machine. Thus, on circuits of higher frequency the alternating current motor will possess not only an enormous advantage over its continuous current brother, in the matter of safe and economical transmission over long distances of the power that gives it its vitality and scope, but will be far superior to it as a motor by reason of its more simple and compact form and the correspondingly increased amount of power it is capable of generating per unit of weight under these conditions.

In addition to the experimental motor here illustrated, we have built other single-phase motors of larger sizes that are now doing successful work in our factory where they can be seen in operation. Some of these motors are designed for synchronous working and run at a constant speed under varying loads. As in the case of the variable speed motor, they are self-starting and run rapidly up to synchronism without the use of a special starting coil or switch, and will automatically gain synchronism should their speed be temporarily reduced below it by reason of a heavy overload.

We are now able to predetermine the characteristics of our motors with as much accuracy as with direct current machines, and, as already stated, we are rapidly completing the designs for a full line of these motors, ranging all the way from a small size ⅙ h. p. alternating current fan motor to the largest motors that may be required for stationary work. We have now likewise in course of construction a single phase high frequency alternating current railway motor of 40 h. p. capacity, which will have less than one half the usual weight and will embody some novel features peculiar to itself that are likely to have an important bearing upon the future of the electric railway.

MISCELLANEOUS.

THE CONSTRUCTION AND USES OF PROJECTORS.—II.—(*Concluded*).

BY F. NERZ.

Every source of light has sensible dimensions. If the source is not a sphere, but only a portion of one, and if the piece which enters into our calculation has the surface of diameter $d = a\,c$ (Fig. 4), and if f be the focal length of the mirror, then those rays which coincide with the radii vectores are reflected parallel to the axis, and the angle included between the rays a A and c A is a measure of the deviation from parallelism produced by the extension of the source of light, and gives the amount of (theoretical)

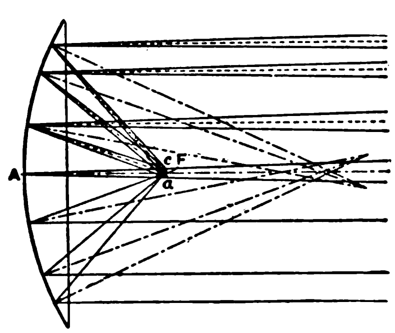


FIG. 4.

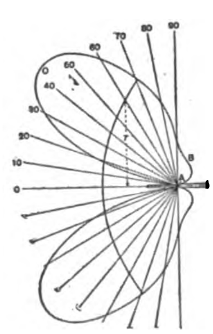


FIG. 5.

dispersion, or the "illumination-angle" for a given source of illumination. The light is similarly dispersed at all points in the mirror, but the angle decreases as the distance from the centre increases; every point produces a cone of light whose axis lies parallel to that of the mirror. As all the axes of the cones lie in a cylinder whose diameter is that of the mirror, but the surfaces of the base of the cones at any distance have different diameters, the illumination produced by a projector must be most intense in the centre and fall off towards the sides. Since the several light rays at a considerable distance from the mirror can alone be considered as coming from a point, but near it cross one another in endless number, objects placed near the projector cast no shadow, and the sharpness of the shadow increases with the distance. The largest angle of divergence of the light rays after reflection is called in this paper the "angle of illumination."

The parabolic form surpasses the Mangin type of mirror, which has a longer focal length, and consequently smaller useful angle. Comparing two mirrors of equal diameter of 60 centimetres, the Mangin form having a focal length of 42 centimetres and the parabolic reflector of 25 centimetres, the useful angles are 83° and 124° respectively; and this gives the amount of light gathered by

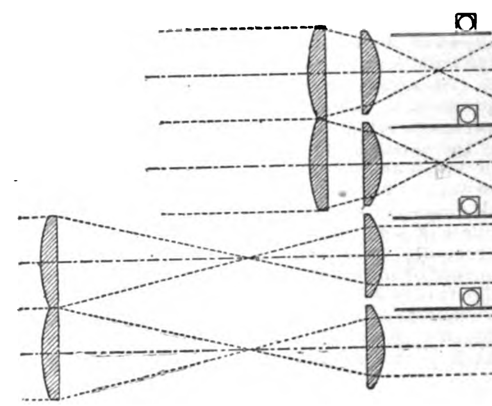


FIG. 6.

each as 1 : 2 11; the parabolic mirror gathering, therefore, rather more than twice as much light.

The arc light is of course generally used now, as it combines with great intensity the nearest approach to a point of light. The spherical form assumed in the above considerations is not a property of this light; the chief source of illumination is the incandescent crater of the positive carbon; the negative carbon emits relatively much less light, and least of all the arc itself; and the negative carbon itself gets in the way of an even distribution of the light emitted. Various methods have been suggested to avoid the losses due to this shadow effect. One of these is to incline the carbons 30° to the vertical, and displace the negative carbon parallel to the positive nearer the object to be illuminated, but this method can only be used with advantage on mirrors of small useful angle such as those of Mangin. For angles over a certain amount, the best arrangement is the arc placed in the axis of the mirror, and its superiority is probably, almost certainly, due to the fact that part of the light emitted by the negative carbon falls on the edges of the mirror, and part is reflected from the positive crater on to it. In Fig. 5, A B C shows the intensity curve of a horizontal lamp. If we consider an element of surface Δ of the mirror, it is illuminated by an intensity f (I), which can be taken from the curve; and the zone of the mirror belonging to this element of surface reflects an amount of light

$$L_1 = \frac{f(\mathrm{I})\, 2\,\pi\, r\, \Delta}{\rho^2},$$

and if we determine these values for particular points on the mirror, we find that they increase from the centre up to a maximum at an angle Φ_x, which is larger than the angle Φ_y corresponding to the greatest value of f (I). Again, if the average amount of light reflected be calculated for increasing values of the useful angle, it will be found to become a maximum for a certain angle Φ_z: and this angle will again be larger than Φ_y. Mirrors which have as nearly as possible this useful angle will have the greatest output. With parabolic mirrors it only remains to choose the proper focal length for a reflector of given diameter in order to secure the greatest possible output.

If the output of mirrors of different diameters is to be compared, all being constructed for the same "useful angle" the intensity of illumination in the field due to the mirror is as great as if it were produced by a source of illumination which has increased from the size of the sphere of light to the size of the mirror without abating in specific intensity.

As the surface of the crater is approximately proportional to the power, but the specific intensity remains, within the limits under consideration, fairly constant, it follows that the brilliancy will not be increased by extra expenditure of power, but only the size of the illuminated field. It follows that as far as brilliancy of illumination is concerned, so long as concentrated light is used, the efficiency of a projector cannot be increased by increase in current, and the current strength should be chosen for a certain diameter of reflector only by consideration of the "angle of illumination." Thus having determined for a certain projector the proper focal length, the second

most important point is to choose the proper current strength in order to produce the maximum illuminating effect for the least expenditure of electrical energy.

Of course there are often points of construction which necessitate deviation from the best possible form of mirror. For use at sea it is not so important to see a ship as far off as possible, but to illuminate the water all round at such a distance that torpedo boats must pass the illuminated zone before coming near enough to do damage, and an instrument to light all round would serve this purpose best; but there is not room, generally speaking, on shipboard for such apparatus, and often in old ships there is not even place for one projector.

To increase the "output" of a projector, as we have seen, it is necessary to increase its dimensions, and practically, mirrors may be about 3 feet in diameter; they cannot be larger, first, because the working of the guns would damage them, and secondly, because they would become too clumsy for use on board. To facilitate the search for torpedo boats, the beam should be spread as much as possible horizontally, and special apparatus is used for this purpose. If the beam has a natural angle of $m°$ which is increased to $n°$, the intensity diminishes in the proportion $m : n$, whence we see that the angle of illumination, and hence the current strength should be as large as possible. It will be seen that under these circumstances the intensity of illumination can be increased by increase of current strength, although of course not in proportion to the extra expenditure of energy, but in proportion to its square root.

There is another point to be noted in this connection, that when the current becomes relatively large, it is necessary to reduce the "useful angle" in order to prevent overheating the mirror, and this is a point of the utmost importance in the design.

The author refers then to the marked contrast observed at the Frankfort Exhibition between the parabolic-mirror search light of Schuckert & Co., and the one with a Mangin reflector by Siemens & Halske. The former firm exhibited a projector having a mirror 166.0 centimetres in diameter—the largest on record. The lamp took 150 amperes and about 60 volts corresponding to an out-

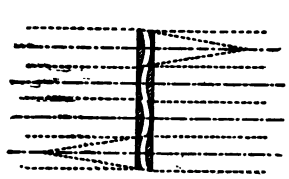


FIG. 7.

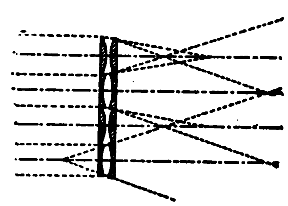


FIG. 8.

put of about 12 h. p. in light. The light was seen 71 kilometres (about 40 miles) distant quite plainly, its "ratio of intensification," D^2 / d^2, being nearly 4,000—that is to say, the effect was as if the projector were replaced by an arc lamp of 222,000,000 c. p., using a current of about 500,000 amperes! Another projector was for use on shipboard; its mirror was 91 centimetres in diameter, and the lamp (arranged like the other for 150 amperes) took 120 amperes; this apparatus was provided with means for varying the horizontal dispersion of the beam between 6° and 45° by simply turning a wheel. The difficulty of changing glasses in front of a projector is naturally well-nigh insuperable, owing to their great weight and surface, and the new apparatus is, therefore, a very important improvement. There was also fitted a signaling apparatus of the "Venetian blind" type, so arranged that it could be permanently fixed to the projector without interfering with its working.

The dispersing apparatus consists of two frames behind one another, having an equal number of cylindrical lenses; the one behind has lenses of greater focal length than the front one. When the glasses are distant from one another by an amount equal to the sum of the focal lengths the light is concentrated, and by gradually approaching each other they disperse the light by increasing amounts up to 45°. In Fig. 6 the upper figure shows the greatest dispersion and the under one the parallel transmission; the shutters of the signaling apparatus are seen in the dark spaces between the lenses.

When the projector is so small that a single shutter can be used for signaling, another kind of dispersion apparatus may be used, illustrated in Figs. 7 and 8. The two frames carry alternate concave and convex lenses; and when they are so placed that the concave comes opposite the convex lens, the frames act like plain glass; but when the converse is the case and concave comes opposite concave by means of a sidewise movement, then the dispersion caused by each frame is increased by the other.

A further improvement was added to these projections by placing motors on their two axes in such a manner as to make them controllable from a distance, a device which is very useful on shipboard; and will continue to be of importance until the present single projectors are replaced by eight smaller ones arranged to illuminate the entire horizon, and this improvement can only be a question of time; only when this is accomplished will the projector have that importance in warfare which it is certainly destined to attain.

STUDIES OF THE PHENOMENA OF SIMULTANEOUS CONTRAST-COLOR; AND A PHOTOMETER FOR MEASURING THE INTENSITIES OF LIGHTS OF DIFFERENT COLORS.—III.

BY PROF. ALFRED M. MAYER.

The explanation of the phenomena of simultaneous contrast-colors, as generally given in works on chromatics, is that they are due to "error of judgment," to "deception of judgment," or to "fluctuation of judgment." The reasoning given may be convincing if all the conditions really exist which the writers assume to exist in their explanations of these phenomena. One of these conditions is that a judgment can be formed in the minute interval of time only necessary in which to perceive contrast-colors. In the experiments just described with the electric flash we have *apparently* instantaneous perception of the contrast-colors in the gray ring placed on the green and ultramarine grounds, in the candle and electric light shadows and even in the very flash itself when this is seen reflected from the top surface of a green glass and from the mirror on which the green glass rests.

Many careful experiments made by me and others, using as chronometer three pairs of forks of the octave of UT_6, giving respectively 10, 12 and 15 beats per second, showed that certainly the interval between the flash and the perception of the colors was less than $\frac{1}{15}$ of a second. Indeed, on viewing the flash and the illuminated surfaces at the same time, or, hearing the discharge and viewing only the illuminated ring, *no interval could be detected* by this mode of observation as existing between the instant of the flash and the perception of the colors, and we certainly could have detected a shorter interval than $\frac{1}{15}$ of a second had it existed.

It is here to be noted that although the after images of the contrast-colors in these experiments with the electric flash lasted about $\frac{1}{2}$ of a second, yet the most careful scrutiny could detect no change in sensation at and immediately following the flash. The contrast-colors, so far as I and others observed, appeared at the moment of the flash. After the instant the image of the flash is formed on the retina there exists, no doubt, an interval of time before we are conscious of the stimulus, whose effects are seen rapidly to rise and then more gradually to fall, falling with two oscillations in intensity, so that all the events of the phenomenon take place in about $\frac{1}{2}$ of a second. However, no vague impression of surfaces merely differing in illumination and then suddenly changing into a color and its contrast-color could be detected. I think that this interval of no color sensation, if it exist, must be of exceedingly short duration; but such a period of light without color cannot be detected, and if it cannot be perceived, then, so far as we are concerned, it appears to me, that there can be no hesitation in the perception of the colors, and "no fluctuation of the judgment" and "dividing between two images the difference in color which really exists" before the mind reaches its conclusion as to the character of the colors.

The following experiments were separately made on three persons between whom no communication had passed as to the nature of the experiments to be tried on them. I placed a gray ring on a ultramarine disc in front of the Holtz machine and requested the observer, who had implicit confidence in my truthfulness, to describe to me as accurately as possible the exact hue of the pink, or rose color, or red he would see on a green ground at the instant of the electric flash. Each observer at once said: "It is not pink; the ring appears yellow on a blue ground." Now in each of these experiments the observer was prepared, by my pardonable lying, to see red on a green ground; and to see yellow on a blue ground his mental condition of anticipation to see red on a green ground was first removed, then a new departure was taken and a judgment formed which resulted in his seeing yellow on a blue ground, and all that in a minute interval of time.

I do not know if psychologists have come to a conclusion as to the smallest interval of time necessary to form a judgment, either true or false, or in which to have a "fluctuation of the judgment," or in which "to exercise judgment and divide between two colors the difference in colors which really exist." If such mental operations can be performed in the millionth, the thousandth, or even in a few hundreths of a second then the explanations of these phenomena, as generally given, may be convincing.

Von Bezold in his "Theory of Color," Boston, 1876, in explaining the fact that a red seen by reflection from a piece of green glass laid on a mirror gives two images one green the other red, says: "As the observer does not *know* which of the two images is the colored one he exercises his judgment, and divides between the two images the difference in color which really exists." Now this experiment is similar in its conditions and in its effects of contrast-color to the one I made on the contrast-colors of the electric flash, when the same colors were distinctly seen apparently at the moment of the discharge. Can one "exercise his judgment and divide between the two images the differences in color which really exists" in an interval of time which is less than $\frac{1}{15}$ of a second?

In the experiment of the colored shadows cast by the candle and by daylight, these colors are explained by Von Bezold (pp. 152,

153), as follows: "The spot occupied by the blue shadow is illuminated by the *white daylight*, the larger white surface by *daylight and by candle light*, the other shadow by candle light only. It might be presumed, therefore, that one of the shadows would appear white, the other yellow. This is not the case, however; for *knowing* the surface to be white we still take it to be white after it has really received the yellow light of the candle. Our judgment is led astray regarding white, and hence we believe the place occupied by the second shadow to be blue, although it is actually white." Helmholtz ("Lectures," N. Y., 1873, p. 267), says: "Thus in the experiment described above of colored shadows thrown by daylight and candle light the doubly illuminated surface of the paper being the brightest object seen gives a false criterion for white. Compared with it, the really white but less bright shadow thrown by the candle looks blue." These explanations assume knowledge and conditions which are not essential. If this knowledge and these conditions were necessary to see the phenomena then these explanations of the phenomena might be convincing; but the conditions they assume are not necessary. The following experiments show that there is no necessity at all in "knowing the surface to be white" or to see "the doubly illuminated surface of the paper."

The experiment of the colored shadows cast by the candle and by daylight was arranged behind a screen, so that no one could divine what was there. A tube blackened on the inside went obliquely through the side of the screen and was so adjusted that the circular field of view through the tube was entirely filled by equal portions of the two shadows, which formed two semi-circles, one colored orange the other blue. The two persons on whom I experimented were ignorant of the phenomena of contrast-color and moreover were misled as to what they would see on looking into the tube, and I was specially careful not to speak to them about color. These persons were strangers to each other and neither knew that the other had been the subject of my experimenting. The first observer at once reported: "I see a circle half yellow and half blue." The other said: "I see a golden band next to a sky-blue band and the golden band is rather deeper in color where it is next to the blue," which is certainly a very good description.

Having in mind the facts established by the foregoing experiments it seems to me that we have either to regard the phenomena of simultaneous contrast-color as psychical phenomena of which no satisfactory explanation has been given, or, we must discard the Young-Helmholtz hypothesis of color sensation and adopt one similar to that of Hering, which gives a direct physiological explanation of contrast-color effects without the physiological considerations which those who adopt the Young-Helmholtz hypothesis are obliged to resort to in their explanation of these phenomena; and which explanations, as I have attempted to show, are faulty, and have to be modified to be convincing.

According to Hering's hypothesis of color sensations when a portion of the retina is stimulated, adjoining portions of the field of view are affected by a sort of inductive action; so that changes are produced which are antagonistic or complementary to those portions of the retina actually stimulated.

M. Foster in his "Physiology, Lond., 1891," Part IV, bk. III, gives an excellent discussion of the relative merits of the Young-Helmholtz hypothesis and Hering's in explaining color sensations. In conclusion he writes . . . "so far as we are aware no crucial test between the two has as yet been brought forward. We may now leave the matter with the remark that while the Young-Helmholtz theory tends to lead us direct from the retinal image to the psychological questioning of the sensations, and seems to offer no bridge between the first step and the last, Hering's theory is distinctly a physiological theory, and at least holds out for us the promise of being able to push the physiological explanation nearer and nearer home before we are obliged to take refuge in the methods of psychology."

COST OF POWER TRANSMISSION BY ELECTRICITY.

At the recent meeting of Section G, British Association, Mr. Gisbert Kapp read a paper entitled "Relative Cost of Conductors with Different Systems of Electrical Power Transmission." The author said that with the alternate current there is no necessity of high insulation of generator or motor, but only of the transformers, which can be easily insulated by the use of oil or other means. The author dealt with five systems of transmission: 1. Single-phase alternating current transmission by two wires; 2. Double-phase alternating current transmission by four wires; 3. The same by three wires; 4. Three-phase alternating current transmission by three wires; 5. Continuous current transmission by two wires. Thus, if for the transmission of a certain power over a given distance by continuous current, 100 tons of copper were required for the line, then the single-phase alternating and the two-phase four-wire system would require 200 tons. The two-phase three-wire system would require 290 tons, and the three-phase three-wire system only 150 tons; therefore, so far as the line might be concerned, there would be a distinct advantage in the employment of the three-phase system.

Letters to the Editor.

BOILER AWARDS AT THE WORLD'S FAIR.

In your issue of Nov. 8th my attention was arrested by the very strange letter coming from the Babcock & Wilcox Company containing a rather weak and roundabout excuse for their non-receipt of an award for their boiler exhibit at the World's Columbian Exposition.

As the writer's position and intimate relation with the boiler plant at the Exposition will vouch for his ability to write on this subject, and knowing that many, if not most, of your readers, are more or less interested in boilers, and especially in this, the largest and most interesting boiler plant the world has ever seen, I beg to offer the following, in order that injustice may not be done to the Exposition nor to the judges who are almost denounced as Know-nothings in this curious combination of words.

Concerning these judges, I would ask, Are they not men of acknowledged standing, experience and integrity in the engineering world, who sacrificed their regular practice at home and virtually gave their service to the World's Fair? Surely it cannot be denied that they contributed not a little to the success of the department in which they acted, establishing a reliable record of the many engineering exhibits which probably would never have been accurately recorded had it not been for their conscientious efforts to discharge the duty which was intrusted to them.

This letter from the Babcock & Wilcox Company states that "it was the purpose of the jury to make awards on boilers based entirely upon the written statements of the exhibitors of boilers, without tests or any personal knowledge in the possession of said jury concerning the comparative construction, operation, economy and durability of said boilers."

It is very true that each one of the manufacturers exhibiting boilers there was asked to make either a written or verbal statement of the points of excellence in his boiler to the judges, but we would ask you and your readers whether these statements were made before a body of laymen entirely ignorant of the subject in question, or were they made before men who were well informed as to the construction and working of all the boilers in operation at the World's Fair? With such men as Geo. H. Barrus, of Boston, and Prof. James E. Denton, of the Stevens Institute of Technology, heading the list of these jurors,—men whose position has made it impossible for them to be prejudiced in favor of any one make of boiler over another, men who have made test after test on most of the leading modern makes of boilers,—it is ridiculous to consider the foolish words of this letter of excuses which, as I understand, would lead the public to believe that each juror was a mere helpless puppet, without professional ability to pass an individual opinion.

As I have already stated, it is true that the boiler manufacturers were asked to testify before this competent jury of experts who were well able to "separate the wheat from the chaff" and investigate not new boilers, but old acquaintances, we might say, which were before them at the Fair, and, with their past experience, judge the points of superiority which each of these manufacturers stated as being contained in his boiler. Besides these mere "written statements of the exhibitors" for the judges to consider, much valuable information has been collected by the engineering corps of the Fair, who had charge of the boiler plant, which in itself, brings out some points of comparison quite worthy of consideration.

Why is it that the Babcock & Wilcox Company shrank when they were called upon to appear before such a jury as this? Could it possibly be that they were afraid to meet these men as their judges after their unfortunate header accident in the World's Fair boiler house in the latter part of May?

One would think after reading this letter from the Babcock & Wilcox Company that they had entered their boiler in the Exposition boiler house with eager expectation for a competitive test, but alas, had been denied the opportunity to show their wonderful production superior to all its neighbors. If this was really what they wished, if they wanted a public record based on the actual performance of their boiler at the World's Fair, why did they not accept the invitation of the Exposition officers and participate in a series of boiler tests which would have been conducted with the utmost care and fairness by such able men as we have named above? If they were so sure of the superiority of their boiler as claimed in this letter, why did they not go on with these tests and challenge all other companies there to compete with them? If they had done this they would most positively have met with a quick response. There was never a better opportunity to prove their boast, and probably it will not occur soon again. On the contrary, when this proposition was made they were, I believe, the very first to "withdraw their boilers from all competition," including such tests.

These facts put this matter in another light which certainly is hard to reconcile with the expressions of their letter. Could it be that they still had fresh in their mind a defeat they met with about a year ago, when they were brought into competition with the Root

boiler, and also with one of the Morin boilers? And besides, could it be that the memory of the close contests they had had on two occasions with the Heine boiler had robbed them of their courage so that they were afraid to stand up before the public with actual performances of their boiler, as would have been shown in such a test? They surely cannot deny that they had such an opportunity presented to them.

I hope that I have not intruded too much on your valuable space with my remarks, which I think will be of some interest to most manufacturers, and especially those who were interested in the boiler plant at the World's Fair.

ALBERT A. CARY.

NEW YORK CITY.

KINTNER'S SAFETY SYSTEM OF ELECTRIC WIRING.

REFERRING to Mr. Caryl D. Haskins' communication in the ENGINEER of November 15 touching my Safety System of Wiring, I beg to say that all that Ferranti had done in the way of concentric wiring was thoroughly familiar to me when I first gave attention to this matter, which was soon after the first description of the Ferranti system. Mr. Haskins may not be aware of the fact that the concentric system of wiring is, broadly, much older than Ferranti's time, having been fully disclosed in a patent granted Mr. Edison on the 4th day of May, 1880, and numbered 227,228.

A concentric system of conductors was also contemplated by another pioneer in the art, namely, Mr. William Edward Sawyer, as is disclosed in his work on "Electric Lighting," on pages 156 and 157, published by Van Nostrand in New York, in 1881. In the systems of Edison, Sawyer and Ferranti, however, the interior conductors were permanently secured in place either in the nature of a concentric cable or an interior conductor insulated by permanent insulation connected to the walls of exterior tubing. My system contemplates at all times the ready removal of the interior conductor and my patents, Nos. 426,127 of April 22, 1890, and 475,-982 of May 3, 1892, are limited to this extent.

The Ferranti system of cables was found to be impracticable for the reason that when the insulation was ruptured it necessitated the taking up of the entire cable for repairs. With my system the exterior or tubular conductor is a fixture, while the interior conductor or conductors is, or are, always removable,—a very material difference, as will be appreciated by those who have to do the repairing of concentric cables. In short, my system contemplates an accessible concentric system from the lights to the commutator brushes, thereby permitting the removal of the interior conductor or conductors in sections for repairs or the substitution of one interior conductor for another where a number of them are so enclosed by an exterior conducting tube or conduit.

With my system, I may add, it is entirely probable that what is known as the Ferranti effect would not be present if the exterior tube be of sufficient interior diameter and the interior conductor be located in the axial centre of the tube and surrounded by dry air.

I may add also for the information of Mr. Charles Wirt, whose letter of criticism upon my system is printed on page 438 of the some issue of the ENGINEER, that my date of invention broadly anticipates what is known as the Andrews system and that a concentric system of wiring may be constructed cheaper than a two wire system where the wires are surrounded by protecting casings.

CHARLES J. KINTNER.

NEW YORK, Nov. 16, 1893.

COST OF STORAGE BATTERY TRACTION.

I HAVE read with interest the description of the Waddell-Entz storage battery cars as given in your issue of Nov. 1. There are, however, a few very important data which are not mentioned and without which in my opinion, the figures as given, regarding the cost of operating, are of comparatively little value, but which with these few extra facts would be of very great value. For example, the weight, size and seating capacity of the cars; the number of passengers carried in the 40,000 miles; the average speed; the number of miles per car trip; the number of sets of batteries per car; the maximum, minimum and mean horse power; the maximum, minimum and mean horse power hours per car mile—would all be of considerable interest.

But above all, what are the physical conditions of the road? Any data, no matter how full, relating to a comparatively level and straight road is no criterion whatever for a road with many grades and numerous curves. Whereas in the former case a maximum of six to eight horse power would be sufficient for a car weighing in all 7 to 8 tons, in the latter from 25 to 35 horse power might be frequently required from batteries and in many instances a steady discharge of from 12 to 15 horse power during a considerable period of time. So far as I remember the portion the 2nd avenue road on which the Waddell-Entz cars have been running is comparatively level.

S. C. C. CURRIE.

NEW YORK CITY.

SOCIETY AND CLUB NOTES.

LOCAL MEETINGS OF THE A. I. E. E.

AT the meeting of American Institute of Electrical Engineers held on Nov. 15, the special Committee of Council appointed for that purpose presented the following report on "Local Meetings of the Institute":

Report of Committee on Local Meetings.

Your Committee, appointed at the meeting of the Institute of October 18, to consider the subject of Local Meetings, beg to report as follows:

1. It is the opinion of the Committee that provision should be made for local meetings of the members at points inconveniently distant from New York for the reading and discussion of papers accepted by the Institute.

2. The Committee is of opinion that the provision in Section VI. of the Rules of the Institute, authorizing the Secretary to "call a special meeting on a requisition signed by fifteen or more members" was not intended to, and does not, cover local meetings of the character contemplated in this report.

3. The Committee presents the following plan for the holding of local meetings of members:

A. When not less than twenty members in any stated locality shall, in writing, notify the Secretary of the Institute of their desire to hold local meetings, such request shall be presented to the Council at its first meeting thereafter. The Council shall then, upon the recommendation and nomination of the signers of the request for local meetings, appoint a Local Honorary Secretary, who shall be a member or associate member of the Institute residing in the specified locality.

B. The duties of a Local Honorary Secretary shall be, in general, to serve as a channel of communication between local members and the general body of members through the Secretary and Council. But no member in any locality shall be debarred from direct communication with the Institute.

C. In any locality where a Local Honorary Secretary shall have been appointed, local meetings may be held, the local members to elect their own chairman, such meetings to be known as "Meeting of the —— Members of the American Institute of Electrical Engineers," and such meetings shall be for the purpose of reading, by the authors or by proxy, and of discussing, papers accepted by the Institute, and such papers only. Such local meeting shall be held simultaneously with the Institute meetings, or subsequently: that is to say, no paper before the Institute shall be read or discussed at a local meeting in advance of its reading at the Institute meeting.

D. Whenever local meetings shall have been provided for, as in the foregoing section, the Local Honorary Secretary shall be supplied, by the Secretary of the Institute, with a suitable number of advance copies of papers to be read before the Institute, which copies he may distribute to the local members of their local meetings. The Local Honorary Secretary shall transmit to the Secretary of the Institute a report of the discussions at each local meeting, together with any written discussions or comments on papers that he may receive from members in his locality. Any member or associate may introduce a stranger to any meeting, but the latter shall not take part in the proceedings without the consent of the meeting.

E. The Local Honorary Secretary shall transmit to the Secretary of the Institute all papers offered by local members, but any member may send papers directly to the Secretary of the Institute.

F. The publication of the discussions at local meetings in the Transactions of the Institute shall be subject to the same regulations and restrictions as govern the publication of discussions at the regular meetings of the Institute. No publication of papers or discussions at local meetings in local or other journals or newspapers is to be permitted without the sanction of the Council or the Secretary of the Institute.

G. The expense of local meetings small be borne by the local members and not become a charge upon the funds of the Institute.

H. The title, name and address if each Local Honorary Secretary shall be printed in the publications of the Institute.

In dealing with the subject before it, and in preparing its report, your Committee has carefully considered the documents and correspondence placed in its hands; particularly the paper of the Secretary on "Monthly Meetings," and the plan for the establishment of chapters of the Institute drawn up by Dr. Emery, both of which were read at the October meeting.

The scheme for local meetings suggested in this report has been designed with the purpose of affording to members distant from the headquarters of the Institute opportunity to participate in its work on substantially the same footing as members whose location permits them to attend the meetings held in New York. The Institute is a national body, having members in every section of the country, but with a large preponderance of membership relatively near headquarters. Its work and its publications have a national significance. Its subdivision into sections or chapters would detract from the unity and strength of its effort to serve the best interests of electrical science and industry. Your Committee, therefore, is of opinion that it would not be for the welfare of the Institute to create any separate local organizations or any class or classes of members not now provided for in its Rules.

It is believed that the plan for Local Honorary Secretaryships and for local meetings herewith submitted would meet fully the desire of members in diverse parts of the country to participate in the work of the Institute and that it would avoid the disadvantage and disintegrating tendency that might arise from the formal establishment of a number of separate and distinct sub-societies.

(Signed) HERBERT LAWS WEBB, *Chairman*,
A. E. KENNELLY,
M. I. PUPIN,
WM. J. HAMMER,
GEO. M. PHELPS.
Committee.

NEW YORK, Nov. 10, 1893.

A spirited discussion followed the reading of the Report, during which it was manifest that the members in and about New York desired to afford their distant fellow members every possible opportunity for obtaining the greatest benefit from their membership in the Institute, but keeping in view always the necessity of maintaining the solarity of the Institute as a national organization. With a few trifling changes, the report was adopted as above.

PRESIDENT HOUSTON announced the following Committee to take up certain lines of work left unfinished by the Electrical Congress at Chicago, more especially the determination of a practical Unit of Illumination, as advocated in his inaugural address: Prof. E. L. Nichols, Cornell University; Prof. Ch. R. Cross, Mass. Institute of Technology; Thomas A. Edison, Edison Laboratory; Dr. Louis Duncan, Johns Hopkins University; Prof. F. B. Crocker, Columbia College; Prof. R. A. Fessenden, Western University of Pennsylvania.

The following Associate Members were transferred to membership upon recommendation of the Board of Examiners; Bion J.

Arnold, Consulting Engineer, Chicago, Ill.; Chas. D. Parkhurst, Lieut. 4th Artillery, U. S. A., Fort McHenry, Md.; Alfred A. Dion, Supt. and Electrician, Chaudiere Electric Light and Power Co., Ltd., Ottawa, Ont.; Chas. F. Uebelacker, firm of E. P. Roberts & Co., Mechanical and Electrical Engineers, Cleveland, O.; Robert McA. Lloyd, Electrician, New York.

LEGAL NOTES.

THE EDISON LAMP CASE IN NEW YORK CITY.—JUDGMENT OF THE CIRCUIT COURT OF APPEALS.

ON November 13 the U. S. Circuit Court of Appeals handed down a decision in the suits of the Edison Electric Light Company et al., vs. the Mount Morris Electric Light Company, et al, and the same vs. the United Electric Light and Power Company. The case had come up upon an appeal from an order made by the Circuit Court restraining the defendants from using in their business Edison incandescent lamps, an order which practically prevented the defendants from using any incandescent lamps in New York City below Seventieth street, as one of the complainants, the Edison Electric Illuminating Company, had acquired from the parent company, the other complainant, the exclusive right to use the Edison incandescent lamps in that territory.

Among the other things the defendants set up laches on the part of the complainants in the manner in which they have enforced their rights by litigation and by their neglect to give infringers timely notice. As to these points the court held that the institution and prosecution of the test case showed proper diligence on the part of the complainants, that the defendants are not entitled to any equitable relief as to installations made since Judge Wallace's decision in 1891, as they could not have been in ignorance of the complainant's rights.

The court ordered that the preliminary injunctions already granted by the Circuit Court be modified so as to enjoin each defendant against the use of infring ng lamps in any building or place not now lighted by either of them or not lighted by them, respectively, prior to July 14, 1891, with liberty to the complainants to renew the motion if, in their judgment, the defendants refuse, upon reasonable terms and for reasonable prices, to pay for patented lamps in buildings in which the use of such lamps is not enjoined. The order also requires each of the defendants to file, within a specified time, with the clerk of the Circuit Court, a list of the buildings then lighted by them respectively, which were not thus lighted prior to July 14, 1891.

By this decision the defendant lighting companies are given the right to supply incandescent lamps to all their customers and plants installed by them prior to July 14, 1891.

SUIT ON THE WORLD'S FAIR INCANDESCENT LIGHTING.—THE FEEDER AND MAIN PATENT.

WE are in receipt of the following information from the General Electric Co., regarding the details of a suit which has just been brought in the U. S. Circuit Court for the Southern District of New York by the Edison Electric Light Company against the New York Insulated Wire Company, and the Westinghouse Electric and Manufacturing Company, for infringement of the Edison Feeder and Main fundamental patent.

The complaint recites that in the installation of the Westinghouse incandescent lighting plant at the World's Fair and its operation the Edison feeder patent was infringed, and that the installation was only rendered practicable by the use of the Edison feeder system of distribution, without which the illumination could not have been done, except at a prohibitory expense.

The original contract made between the Columbian Exposition Company and the Westinghouse Company called for generators, exciters, switchboards, conductors, switches, instruments, regulating and controlling devices necessary for the service of 89,622 incandescent lamps, of which 47,000 were installed. The contract further stipulated as follows: "The pressure not to exceed 2,400 volts at the switchboard, and the pressure on the secondary circuits not to exceed 110 volts. Each primary circuit shall be so proportioned and operated that the maximum loss of the electromotive force from that measured on the feeders to that measured on the converters shall in no case exceed fifteen per cent. That the secondary circuits shall be so proportioned and operated that the maximum variation in electromotive force thereon shall not exceed two per cent."

Patent No. 264,642, granted to Edison September 19, 1882, covers broadly the combination of two portions of a circuit in a system of electrical distribution by which uniformity of action of incandescent lamps or equivalent translating devices throughout an area covered by any plant may be secured without excessive investment or cost of conductors.

The contract for wiring the grounds and building was sub-let by the Westinghouse Company to the New York Insulated Wire Co., which did the work in accordance with the specifications of the original contract made between the Exposition Company and the Westinghouse Co.

This suit promises to be one of the most important in the history of electrical litigation. It is analogous to that recently decided at Trenton against the Westinghouse Co. as defendant, in which Judge Green of the U. S. Circuit Court, of the District of New Jersey, in his decision said:

"I think it is clearly proved that he (Edison) was the first to conceive of such an arrangement and proportioning of the consumption and conducting wires of a circuit, that the inevitable result would be to secure uniformity of pressure throughout the whole system. He was the first to divide a circuit covering a large area into smaller consumption circuits in which the drop in tension would be negligible without the expense of a very large sum of money in increasing the copper in his wires. He was the first to obtain the equalization of candle power; he was the first to supply the consumption conductors with feeding conductors, set apart for that purpose only. He was the first to localize, upon feeding conductors, the drop in tension so that the loss upon the consumption conductors was always negligible."

It is a well recognized fact that it is practically impossible to distribute electricity over a large system of conductors at even approximately constant pressure, without employing the fundamental principles of the feeder system, and these, it would seem, were employed very extensively in the World's Fair lighting installation.

A similar suit has been filed against the Mount Morris Electric Light Company, with which is adjoined the Westinghouse Company, as co-defendant for infringement of the same feeder patents in New York City.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NEW WENSTROM ELECTRIC COMPANY.

THE many admirers of Wenstrom apparatus will be glad to learn that a new company has been organized in Baltimore with ample capital and under capable management, to take up again its manufacture. The president of this new company is Mr. G. M. Hutton, of Baltimore; while the vice-president and manager is Mr. Joseph P. Smith, the well-known builer of the Lake Roland Electric Railway,—a road most of which in the city of Baltimore is an elevated electric railway. The gentlemen above named, together with Messrs. Latrobe, Enoch Pratt, and other prominent capitalists in Baltimore, have organized the new Wenstrom Company and are already turning out this well-known type of apparatus, at the factory of the company in Calverton (a suburb of Baltimore).

The new company, to use the happy expression of Mr. Smith, is organized "without wind and without water," each dollar of stock being paid for by a dollar in good money. It is claimed that since the old Wenstrom Company sank into obscurity, valuable patents, controlled by the company, have been more and more widely and openly infringed by the manufacturers of dynamos and motors; this seems to be particularly the case in the matter of armature winding. One of the patents which has now come into the possession of the new Wenstrom company is that of J. Wenstrom, No. 381,451, dated April 17, 1888, involving a method of armature winding in connection with the use of grooves or holes in the armature drum.

A sum of money has been set aside by the new Wenstrom Company to cover legal expenses which will be involved in prosecuting all electrical manufacturing companies which have infringed this patent, and from information in possession of Mr. Smith, it would seem that there are a number of such concerns who have been inclined to believe that the Wenstrom apparatus, the Wenstrom patents and the Wenstrom company all disappeared together and forever.

Under the management of Mr. Smith, who has thus far achieved success in everything he has undertaken, the Wenstrom Electric Manufacturing Company may be expected to participate largely in the sale of all kinds of electric power and lighting apparatus from now on.

THE WADDELL-ENTZ STORAGE BATTERY ADOPTED ABROAD.

WHEN Direktor Mueller, of the Aktiengesellshaft Hagen, who manufacture the well-known Tudor cell in Hagen, Germany, visited this country during the past summer, he investigated very closely the operation of the Waddel-Entz storage cars on the Second Avenue Railroad in this city, and also devoted special attention to the methods of manufacturing the cells. As a result of these investigations the Aktiengesellschaft Hagen has now taken out licenses for the manufacture and use of the Waddell-Entz cells in Germany, Austria and Switzerland. Machinery for the manufacture of the cells has already been sent abroad, and we understand that a street railway line in Berlin and another German city will shortly be equipped with the Waddell-Entz batteries.

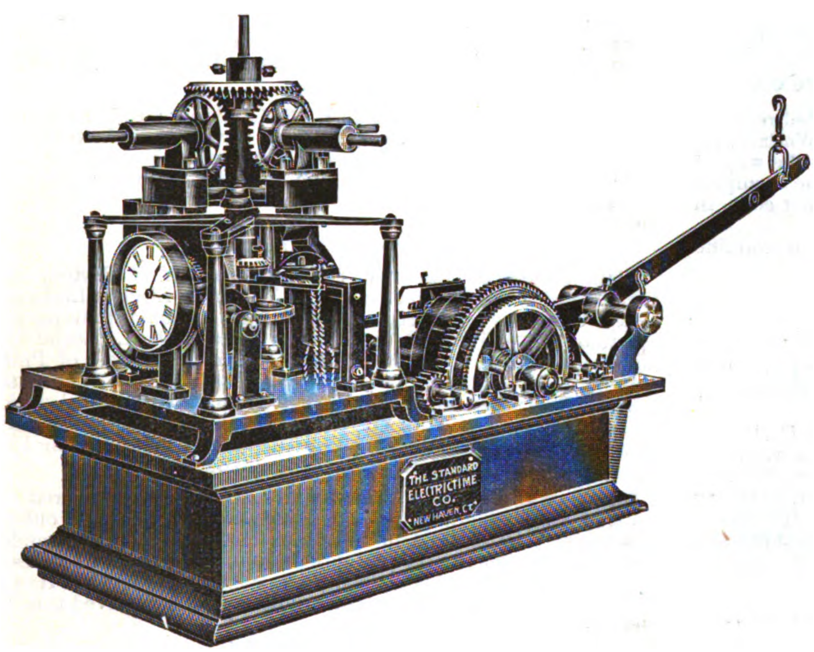
The acquisition of these rights by one of the largest manufacturers of storage batteries in Europe, is a high compliment to the merits of the Waddell-Entz storage battery and augurs well for

its success in this country. We may add that the Waddell-Entz cars on the Second Avenue line in New York City now run regularly between 127th street to Astor Place, and the increased number of fares taken by the electric cars speaks volumes for their qualities.

THE STANDARD TOWER CLOCK.

Among the recent uses of the electric motor is that made by the Standard Electric Time Co., of New Haven, Conn., in operating their tower clocks. Two electric motors are used. The one for driving the hands is connected by a gear and worm to an upright shaft, on the top of which is the usual gearing for the dial works. The motor circuit is closed every minute by a pair of magnets connected to a fine self-winding regulator, and after making the required number of revolutions to move the hands through a space of one minute on the dials, breaks its own circuit and there rests until the regulator closes the circuit on the next minute. A large size of motor is used to operate the striking mechanism, and its size varies according to the weight of hammer to be used. In this case the circuit is closed once an hour, and after striking the required number of blows breaks its own circuit, and then rests until the circuit is again closed.

Some realization of the labor saved by this arrangement may be gained when it is understood that in the ordinary tower clock



The Standard Tower Clock.

operating four pairs of 6 foot pointers, and striking the hours on a 1,000 pound bell, requires from 1,500 to 2,000 pounds of weight, that must be wound up every eight days, besides the regulating necessary to keep it correct, which, owing to the extremes of temperature, makes accurate time impossible. One of the most important features of this arrangement is the use of the ordinary open-circuit batteries for operating the motors. The motors are so wound that but a small amount of current is used, and they will last from one to two years without renewing the elements, which consist of only sal ammoniac and zinc; and only ten cells are required for operating the hands of four 6-foot dials. The number used for operating the striking mechanism varies according to the weight of the hammer used. The speed of these motors is very slow; the efficiency high, and they are arranged so that they will always start, even with a dead load.

By dispensing with the ponderous weights used in the ordinary clock, the weight in the tower is greatly reduced. The electric tower clock complete, as shown in the accompanying illustration, will weigh about 400 pounds, while a weight clock suitable for similar work will weigh from 1,500 to 1,800 pounds exclusive of weights. Another advantage of this arrangement is the fact that secondary dials may be operated throughout the building from the same regulator, which being placed in some office in the building where the temperature is comparatively unchangeable, will keep much better time than a clock that is placed in the tower and exposed to great extremes. Both the time and striking machinery is very simple; being operated directly by gears it is not liable to become disarranged in any way.

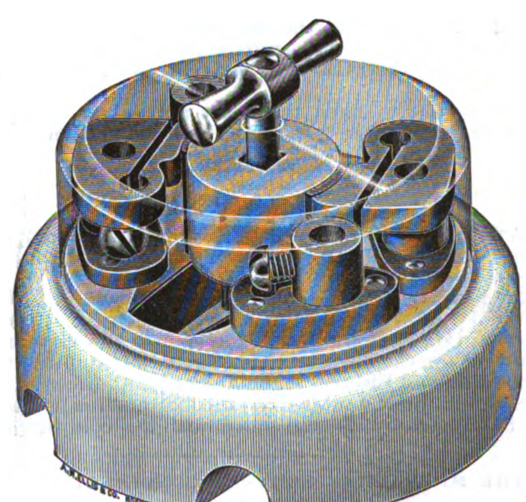
The company is now placing one of these clocks in the tower of the Waterbury Clock Company's new building at Waterbury, Conn.

"PARANITE" FIREPROOF WIRE.

"Paranite" fireproof wire was put to an interesting test in the laboratory of the Massachusetts Electrical Engineering Company last week in Boston. The test was made before members of the Boston Board of Fire Underwriters and the New England Insurance Exchange, and was intended to show the wonderful properties possessed by this wire in resisting internal heat from a wire carrying an excessive amount of current. The wire is waterproofed with the India rubber and Insulated Wire Company's ordinary insulation, but in the special wire tested, a special fireproof covering was put next the copper wire underneath the insulation. The samples submitted for the test were made to carry excessive currents until the copper was white hot, but after cooling off, the insulation was found to be in perfect condition, and it seemed to be an impossibility to burn up the insulation with any amount of heat generated by current in the copper.

A NEW IONA SWITCH.

The accompanying illustration shows a new double-pole switch being placed on the market by the Iona Manufacturing Co., of 836 Congress street, Boston, and said to be the smallest switch made. It is simple in construction, durable, convenient for



A New Iona Switch.

making connections, and each switch has marks showing its condition, whether "on" or "off."

The Iona Co. have just published an interesting catalogue showing this switch and other specialties of their manufacture.

THE AMERICAN MANUFACTURING & ENGINEERING CO.

Mr. Willard M. Miner whose name is familiar to many electricians, has just been appointed electrician and general manager of the American Manufacturing & Engineering Co., of 96 Broadway, New York. This company is prepared to furnish electrical supplies, install electric light and power plants and to undertake electrical engineering work of all descriptions, including consulting work. It is also proposed to devote special attention to the working out and placing on the market of electrical inventions in all branches.

STIRLING BOILERS AT THE WORLD'S FAIR.

The Stirling Co. write us that the position taken by them early in the year to break down the apparent combination of water tube boiler manufacturers, to keep them from exhibiting at the World's Fair, has been fully confirmed by their having been given the highest award covering all claims originally made, especially that of handling bad feed water. The constant and uninterrupted service night and day, rendered by the 2,800 h. p. of their boilers in use at the Fair from May 1 to Nov. 1, won for the Stirling the unqualified approval of all members of the Executive Board.

The Stirling Co. have recently sold to the Providence Union R. R. 1,000 h. p. in four units of 250 h. p. each, for immediate delivery, this order being given after severe competition, in which the merits of the Stirling were fully substantiated.

J. G. WHITE & COMPANY IN BALTIMORE.

THE SOUTHERN DEPARTMENT of J. G. White & Company, under the direction of Mr. E. A. Lewis, has been doing phenomenal work in the equipment and construction of the Baltimore trolley roads. The gentlemen connected with the Department are: Mr. E. A. Lewis, manager; and Messrs. C. G. Young and S. W. Childs, superintendents. Up to the present time, they have not only done all the construction work in connection with the Baltimore trolley roads, but have rolled up the magnificent total of 100 miles of actually completed overhead equipment. This mileage is divided up as follows: The City and Suburban Street Railway, 25 miles; the Baltimore Traction Company, 55 miles, and the Lake Roland Electric Railway, 20 miles. This certainly is a record to be proud of.

PELTON WATER WHEELS.

THE PELTON WATER WHEEL Co. have received, they inform us, the highest award given on water wheels at the Columbian Exposition. The exhibit of this Company consisted of two Pelton wheels operating electric generators—illustrating in a practical way the method of transmitting power by electricity—a system now coming into extensive use in all parts of the country where water is available for power. The water for the wheels above referred to was furnished by steam pumps run under a pressure equivalent to a head of some 600 feet.

A NEW RECEIVER FOR THE ANSONIA ELECTRIC CO.

MR. C. S. MERSICK, of New Haven, has been appointed receiver of the Ansonia Electric Company, to succeed J. B. Wallace, resigned. It is said that the only creditor who stood in the way of a compromise was the Ansonia National bank. The compromise was on the basis of 10 per cent. in cash and 50 per cent. in notes.

The motion to have the court appoint an expert to examine the books of Wallace & Sons has been withdrawn.

THE COMPLETE ELECTRIC CONSTRUCTION CO.

AT a recent meeting of the directors of this company at their offices, 121 Liberty street, New York, the following officers were elected:

John A. Seely, president and general manager; W. H. Baker, of the Postal Telegraph Co., vice president; C. O. Baker, Jr., of Baker & Co., platinum refiners, secretary and treasurer; Geo. G. Ward, of the Commercial Cable Co., and Geo. F. Porter, secretary of the National Electric Light Association, directors. Mr. Baker retains his interest with Baker & Co., and his position there will not be affected by his connection with this company.

THE MILWAUKEE GENERAL CONSTRUCTION COMPANY.

MR. F. H. PRENTISS, well known to the electrical trade generally and as well an officer of the Buckeye Electric Company, manufacturers of the "Buckeye Lamp," has with several gentlemen prominent in business circles, formed the Manhattan General Construction Company, with offices in New York, Chicago and Baltimore. The object of the company is the securing and complete construction of arc and incandescent plants on a large scale; also the entire construction of electric railways. The names of the gentlemen comprising the company are: F. H. Prentiss, president; S. Marsh Young, vice-president and general manager; Henry M. Steele, treasurer; Russell W. Hildreth, secretary. These names are a sufficient guarantee of the high class of the work that will be undertaken. Parties having franchises, etc., and desiring them taken up and pushed to a successful commercial standpoint should address the president, Mr. F. H. Prentiss, No. 753 Monadnock Building, Chicago.

THAT new and enterprising supply house, the Metropolitan Electric Company, of Chicago, has just received a cargo of electric light carbons, consisting of ½ x 12 and $\frac{7}{16}$ x 12, and ½ x 7 and $\frac{7}{16}$ x 7, both plain and plated. They are thus in a position to handle the largest orders promptly. Dealing in this large way with manufacturers, enables the Metropolitan Electric Company to sell at first hand prices.

The title of this company is new but its personnel is too well-known in the electrical trade to need mention. Under the direction of its president, Mr. W. H. McKinlock, its business is sure to be conducted on correct principles and such as in the long run are to the advantage of both buyers and sellers.

A READER and advertiser in England writes us: "I desire to acknowledge the excellence of THE ELECTRICAL ENGINEER as an advertising medium."

A LARGE ELECTRIC PLANT FOR BALTIMORE.

IT seems as if the long delayed project for a comprehensive system of electrical distribution in Baltimore is soon to be realized. The Maryland Electric Co., which now operates a station with the Fort Wayne Electric Co.'s apparatus, and of which Mr. J. Frank Morrison is general manager, we understand has recently taken steps towards the erection of a 12,000 h. p. central station intended for the distribution of current for heat, light and power. Ground has already been acquired near the water front, and it is said that $2,000,000 will be invested in the enterprise; $1,000,000 of this amount has already been issued in bonds.

Recently a large power station was erected on South Paca street, which is intended as an adjunct to the larger one still to be built. The Edison underground system will be employed and the whole enterprise will have the support of the General Electric Co.

NEW YORK NOTES.

MR. GEO. L. COLGATE, of 136 Liberty street, has recently become the American sales agent for the products of Joseph Sankey & Sons, of Bilston, England, who make stampings for electrical apparatus—armature discs, washers, transformers, etc. They use the best charcoal iron, and the stampings are free from all bur. They make drum, ring, Siemens H, bipolar fields, etc., and all transformer laminæ. Mr. Colgate has already opened up a good market, as the manufacturers of dynamos, motors, etc., who buy from him find that there are important features of excellence and economy in using this line of goods.

MR. HENRY G. ISSERTEL, E. E., 89 Cortlandt street, announces himself as an "electrical middle man between manufacturer and consumer." He will devote special attention to electric light and railway supplies, in both of which fields he has had a large experience.

NEW ENGLAND NOTES.

THE CAMPBELL ELECTRIC SUPPLY COMPANY of Boston, have been awarded the contract from the Westboro Electric Light and Power Company of Westboro, Mass., for a 1,000 light alternating dynamo, and will furnish in a few days one of the La Roche dynamos, manufactured by the La Roche Electric Works, of Philadelphia, for whom they are agents in New England. This is the first La Roche generator which has been sold to a central station in New England and its performance is looked forward to with interest by all. The Westboro Company are at present using both Thomson-Houston and Westinghouse apparatus.

THE HAWKS ELECTRIC COMPANY, of Boston, have secured the contract from the town of North Attleboro, Mass., for the outside construction work on their new municipal plant. 566 incandescent lamps of 30 candle power will be installed and 57 miles of wire will be used. This is the largest contract which Mr. Hawks has yet secured, and the fourth contract he has received this fall from municipal plants.

THE new car barn for the Easton Traction Company, at Easton, Pa., will be build by the Berlin Iron Bridge Company, of East Berlin, Conn. It will be entirely of iron, 64 feet in width and 200 feet in length.

PHILADELPHIA NOTES.

MESSRS. HARRY S. SMITH & CO., LTD., have been awarded the contract for the engines, dynamos and switchboard for the State Hospital for the Insane at Norristown. The plant will be direct-coupled, two 16″ × 16″ "Ideal" engines and two 80 k. w. Waddell-Entz generators being used. The plant will be installed under the supervision of W. A. Drysdale, Consulting Engineer. The wiring of the buildings will be done by Bloomer Bros., New York.

BIDS are being received by the Town Council for an electric lighting plant for the Borough of Ambler, fifteen miles from Philadelphia on the Reading Railroad. There will be several miles of pole line and a 1,000 light alternator will supply an arc and a series incandescent street circuit and two commercial circuits.

SOUTHERN NOTES.

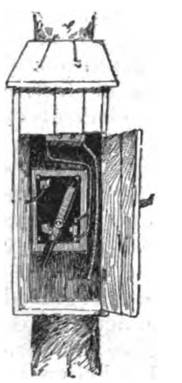
MR. W. OSWALD, formerly general manager, secretary and treasurer of the Southern Electrical Mfg. & Supply Co. has opened a supply house at 42 Union street, New Orleans.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. NOVEMBER 29, 1893. No. 291.

ELECTRIC LAUNCHES AT DEAL LAKE.



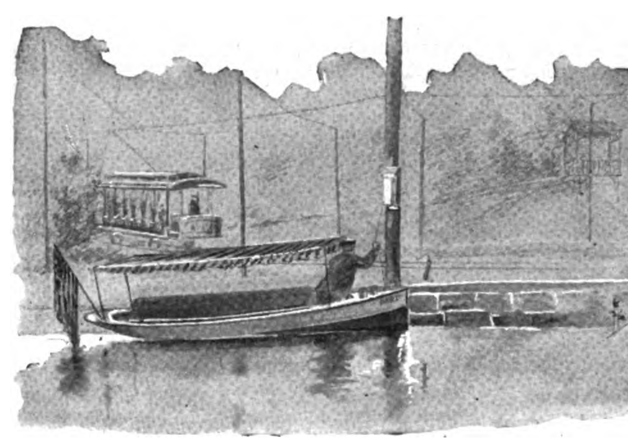
"*Charging Station.*"

Electric navigation has evidently taken hold of the public. The popularity of the beautiful launches at the White City has led to a number of similar, though smaller, enterprises all over the country besides largely increasing the number of private individuals using electricity instead of naphtha or steam for yacht tenders and small craft generally. The successful experiment of November 18, on the Erie canal, described and illustrated in The Electrical Engineer of Nov. 22, was a distinct departure in navigation, inasmuch as the trolley was employed instead of storage batteries and the boat was transformed into a floating street car—without a fender. This system now bids fair to become thoroughly commercial on canals; the other has already become so on lakes and rivers, and it now seems timely to describe what may be called a combination system that possesses advantages and possibilities entitling it to serious consideration.

There are, throughout the country, electric railways in plenty running through picturesque suburbs, watering places and summer resorts, skirting navigable streams or terminating at the shores of lakes and bays. Thousands of pleasure seekers and rest seekers are carried daily to these charming spots where the railway people turn them loose to fall into the hands of the boatmen for the rest of the day. One railway manager, however, conceived the idea of being his own boatman and keeping the public himself. He carried out his plan with whatever old apparatus he had at hand, or could secure; operated two boats all last summer and is so well satisfied with the success of his combination plant that next year he intends to materially enlarge his fleet and equip it with improved apparatus.

The Seashore electric railway at Asbury Park, New Jersey, runs for some distance at the northern end of its route near the shore of Deal Lake, a very pretty little body of water separated from the ocean only by a low range of bare sand dunes and reaching inland in labyrinthine fashion, its bare banks changing with surprising rapidity to cool mossy terraces covered with trees and undergrowth. At the ocean end, the road makes a turn within about fifty yards of the lake. This point was selected for the "charging station," a view of which appears at the head of this sketch. Before discussing this structure, however, it will be well to speak of the boats themselves, as they are, I think, unique among electric craft. The flagship, "Bonaventure," is a flat-bottomed boat thirty-six feet long, seven feet in beam, draws eighteen inches of water and will carry thirty-six people at the rate of eight miles an hour. It is equipped with 110 cells of Julien battery in series, modified to suit existing conditions, as will be explained, and a Crocker-Wheeler motor of two horse power running at a potential of 220 volts. The motor shaft is one inch in diameter and drives an eighteen inch propeller. The boat has run for twelve hours on a single charge. The "Dart" is thirty-two feet long and seven and a half feet in beam with two and a half feet draught. Unlike the "Bonaventure" it is clinker built and has a round bottom. Fifty-five cells connected in series supply current at 110 volts to a Crocker-Wheeler motor in the centre of the boat directly connected by a one inch shaft to a twenty-two inch two-bladed screw, making 600 revolutions a minute. The "Dart" carries twenty-five people at an average speed of ten miles an hour and can make, it is said, sixteen miles an hour at a spurt. A Crocker-Wheeler rheostat of enameled wire coiled about cylinders of asbestos paper to prevent vibration, controls the motor and is provided with stops for seven speeds.

The batteries, as stated, are old Julien cells formerly used on street cars and for some time before being assigned to their present work, occupied a conspicuous place in the scrap heap of the railway company. When it was decided to try them on the launches, each alternate plate was removed, increasing the distance between the remaining ones to three-eighths of an inch. This, of course, gives a much higher internal resistance, but, on the other hand, the cells do not give out quite so often, and the company preferred resistance to investment in new cells during the experimental stage.

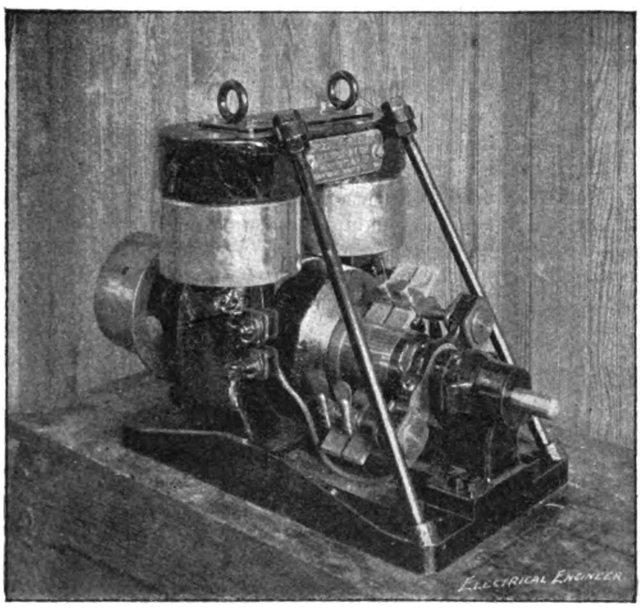


Charging the "Dart."

But the chief novelty is the method of charging, and it is here that the possibilities of the system are most manifest. The street railway feeder, fifty yards away is simply tapped and a line run down to what has been called the "charging station," but which is in reality a small box nailed to a post and containing a cut-out switch, an ammeter and a fifty-ampere fuse. The railway takes a current with a potential of 500 volts and this pressure is reduced for the launches by a process that would turn any self-respecting Pre-adamite green with envy. After passing the switch, fuse and ammeter in the box, and the batteries in the boat, the circuit leads to an old iron pot sunk in the mud at the end of the pier. A section of iron pipe is stuck loosely in the dry sand above high water mark and this is connected to the railway return

circuit. It will thus be seen that to vary the potential it is only necessary to push the iron pipe farther down into moist sand or pull it up a little where it is drier. I think there is no patent on this system of regulation. The batteries are charged with a current of fifteen amperes at about 140 volts.

Primitive as is this whole arrangement, it is certainly suggestive, and points the way to further development of the same idea. With modern apparatus and methods it seems probable that railway companies operating roads where such a scheme is practicable, might give good service and add to their revenues at the same time. Mr. A. S. Hickley, general manager of the Seashore Electric Railway Co., with whom the plan originated, an electrician known to many readers of this journal, is much pleased at the result of his first season's work, and intends improving it next summer and putting it upon a really commercial footing. The fact that with such apparatus—all old except the motors—two old boats could be run for three months



CROCKER-WHEELER ELECTRIC LAUNCH MOTOR.

and make money without charging exorbitant fares, certainly shows that thought, work and capital expended in perfecting such a system might be well invested.

SOLDERING THE ELECTRODES OF ACCUMULATORS.

In the *Foreign Abstracts* of the Institution of Civil Engineers, an improved method of soldering the electrodes of storage cells is described by Messrs. K. Strecker and Th. Karrass. In view of the increasing use of storage batteries for telegraphic purposes, the authors found it desirable to devise means of joining up the lead plates more perfectly than by the soldering iron, which frequently effects merely a superficial union; and more easily than with the gas blow-pipe, which is not very portable and requires practice to use it. They have worked out the following method: The strips of lead for making the joints are immersed for some time in strong potash solution, and then well washed with water to clean the surface. Immediately before the operation the ends of the electrodes and the lead strips are carefully scraped bright; they are then held in position in a mould somewhat in the form of a pair of tongs, which completely encloses the proposed junction beneath and at the sides. Melted lead is then poured in from a ladle till the mould is full. After a little practice it is easy to get the right temperature to ensure the superficial melting of the two surfaces by the hot metal, and make a perfect joint.

ENGLISH WIRING AND INSULATION TESTS.

BY

J. Appleton

THE question of house wiring, and the insulation resistance of the same when complete with fittings and fixtures is one which is of considerable interest to most electrical engineers, and some experience of the customs and practice in England (where probably the matter has received more attention from all parties concerned than in any other country) may be of interest for the sake of comparison.

Cheap and nasty work in this line brought failures and accidents which created a want of confidence in electric lighting, and caused it to be looked upon as an element of danger when brought into the dwelling house This prevailing idea and the exaggerated reports of accidents caused by electricity in this country led the fire insurance companies to inquire closely into the subject, and it is due chiefly to their action that the high class of work generally found in England has become the standard.

The Phœnix Fire Office rules became the recognized rules and most installations are carried out in accordance with them. Rigid inspection is enforced before the fire policy is endorsed, and many a contractor has known to his cost that the penalty of ignoring these rules means pulling out and re-doing his work. The fire insurance companies were backed up in this matter by the electrical supply companies and every home or dwelling is carefully examined and tested by them before they will connect to their mains, and even then, if the periodical tests show that the insulation resistance has fallen below their specified figure, they mercilessly cut off the circuit and notify the proprietor that until his installation is brought up to their specification they are unable to supply him with current. In this regulation they are upheld by the Board of Trade, the Government department which has jurisdiction over this business.

Specifications for wiring and Fire Office rules contain among others the following requirements: The use of cables and wires of 98 per cent. conductivity, insulated with a layer of pure rubber, then a coating of vulcanized rubber taped, braided and compounded, having an insulation resistance of not less than 300 megohms per mile after 48 hours immersion in water when tested with 400 volts after one minute's electrification.

In damp places a resistance of 1,000 megohms per mile is required. No smaller wire than No. 18 B. W. G. to be used, and all wires of a larger sectional area than No. 16 B. W. G. to be stranded.

The current density in no case to exceed 1,000 amperes per square inch, and the fall of potential between the mains and the farthest point to be not more than 2 per cent.

All wires passing through walls to be carried in separate earthenware or other fireproof tubes.

No circuit to carry more than ten amperes, and every circuit when leaving the distribution board to be controlled by a double-pole quick-break switch and a double-pole fuse.

All small switches, cut-outs and ceiling rosettes to be mounted on highly insulating and non-combustible material (usually porcelain) and so constructed that no metal parts carrying current or forming part of the circuit are exposed.

All their working parts to be easily accessible, and to be fixed to the bases, so that they can be removed from the front, no screws or metal parts forming part of the circuit to project through to the under side of the base. All ceiling rosettes to have cord-grips to prevent the weight of the lamp, socket and shade being carried by the terminals. If slate or marble is used for the distribution and switchboards

it must be polished, and a separate piece provided for each pole, the two pieces being efficiently insulated.

The insulation tests to be made when the insulation is quite complete with a voltage equal to that which will be used on the circuits.

The following list shows the standard of insulation required by the leading supply companies and Fire Insurance offices in London :

NAME AND SYSTEM.	INSULATION RES.				
	10 lamps	25 lamps	50 lamps	100 lamps	1000 lamps
	MEG.	MEG	MEG.	MEG.	MEG.
City of London Elec. Supply Co., High Tension Alternating..................	7.5	8.0	1.5	.75	.075
Metropolitan Elec. Supply Co., Westinghouse Alternating..................	5.0	4.0	2.0	1.00	.10
Kensington and Knightsbridge Co., Low Tension and Batteries..................	5.0	2.5	1.5	1.00	.10
Chelsea Elec. Supply Co., Medium High Tension and Batteries..................	8.4	4.0	1.9	1.00	.10
St. Pancras Vestry, Low Tension and Batteries..................	10.0	8.0	4.0	2.0	.2
Phœnix Fire Office Rules for Continuous Currents..................	10.	5.0	2.5	1.25	.125
Phœnix Fire Office for Alternating Currents..................	double the above.				
Other leading Fire Insurance Companies	allow one twenty thousandth of total curent as leakage.				
English Institution of Elec. Engineers	allows one five thousandth of total current leakage.				

The electric supplies have been the subject of much care and attention, and the makers, together with the porcelain manufacturers, have succeeded in producing a very high-class article. The porcelain manufacturers have laid themselves out to cultivate this branch of the business which has assumed very large proportions, and they are now able to turn out a switch or cut-out case, which is not only an artistic thing to look at, but is equally artistic from an electrical point of view.

All the screw-holes in the porcelain for fixing the metal parts, are tapped with a thread which is nearly, if not quite, equal to any thread tapped in a piece of metal, and gives quite as firm a hold to the screw or terminal. This method of making small switches, cut-outs, etc., is admirable, and will no doubt be universally adopted; it has so many advantages over the method of using screws from underneath filled in with cement. It does away with the chance of any leakage and consequent lowering of insulation resistance at the joints where it is most likely to occur, for it is well known that the wiring of any installation may test all right before the distribution boards, switches and cut-outs are fixed, but if the building is new or the walls are damp, down comes the insulation resistance when these accessories form part of the circuit.

By dividing up the installation into small circuits with the use of distribution boards, the number of joints in the cables is greatly reduced and this materially decreases the chance of faults, for experience teaches that no matter how carefully a job is supervised and the best of labor only employed it is very difficult to insure every joint being made so that the insulation resistance is permanently maintained. This method of wiring has become general and owing to the greater facilities it gives for examination and testing has been the means of preventing a lot of the "jerry" work that used to be found.

The interior conduit system has not been much used in England; this is probably due to the fact that it has not been worked out in detail so successfully as in this country. There have been some attempts made with this class of wiring, but they have not met with much encouragement or success.

Great improvements have been made in the electroliers, brackets and pendant fittings; the makers have taken advantage of the pliability of the system and are breaking away from the old-fashioned, stiff designs which have done good service as gas chandeliers. They are introducing some very artistic and pleasing goods specially constructed with a view to easy wiring and fixing.

Since the fire office and supply companies have enforced their rules, there have only been one or two cases of fire, and in these the damage was very slight, and the fire insurance companies now advertise that electric light when properly installed is the safest method of artificial illumination.

WORLD'S FAIR DEPARTMENT.

"PORTABLE JUICE" vs. PORTABLE POWER FOR PORTABLE ILLUMINATION AT THE WORLD'S FAIR.

BY

R. H. Chamberlain

STORAGE batteries have been the "scapegoat" so much during the past few years, that the writer feels they should have full credit when they have accomplished something novel and difficult. He would like to mention one instance out of his recent work at the Fair.

Shortly before the great Chicago Day at the World's Fair the energetic Chairman of the Board of Trade Float Committee was looking for "portable juice" for the illumination of their handsome and artistic float for "Chicago Day" night pageant, and was kindly referred to the writer by Mr. E. J. Spencer of the General Electric Company. After a number of consultations between the designer, the Board of Trade, and the Electric Launch and Navigation Company it was decided to ornament the float with 300 8-c. p. full-sized frosted lamps, taking ½ ampere at 60 volts. For this work the Electric Launch and Navigation Company supplied from their stock of Consolidated Electric Storage Co. batteries, on a separate truck, 7 groups of 33 cells in series.

It was with considerable quaking we awaited the result of our bold proposals and supplies, for it was intended to have in the parade the General Electric Company's "Dragon," with 1,000 small 6-c. p. incandescent lamps furnished with current from a complete boiler, engine and generator on a truck. It was a contest between "portable juice" and portable power plants. Should we fail, and they succeed, the batteries would indeed be the subject for sarcastic mirth. However we "let her go." From the start to the finish not a cell or battery contact was touched, and the success of the enterprise may best be stated by quoting from the Chicago *Inter-Ocean* of Oct. 10, 1893:

"If the enthusiasm was great over these floats, it brimmed over when the floral "Commerce" sailed in. The people went wild over the beautiful picture on wheels. After it had entered the grounds the sail of the boat was

hoisted. Then ribs of light, looking like pearls, burst into flame along the sides of the boat, and rings of fire adorned the mast and cross-trees. The float disappeared around Festival Hall, arousing cheers at every revolution of the wheels."

The Board of Trade were as well pleased at the results as the Electric Launch and Navigation Company, and many blessings fell on the batteries for their noble work. Imagine 231 storage batteries, weighing 9,000 pounds, on a truck *without springs*, and part of the time going over a rough, rocky road to reach the Fair Grounds!

It is the writer's belief that never before was such a successful float illumination on such a grand scale accomplished by the use of *any* electric power. Regarding the "Dragon" and its power plant—well, it may work at the next World's Fair; it didn't at this.

MR. TESLA'S PERSONAL EXHIBIT AT THE WORLD'S FAIR.

WHILE the exhibits of firms engaged in the manufacture of electrical apparatus of every description, at the Fair, afforded the visitor ample opportunity for gaining an excellent knowledge of the state of the art, there were also numbers of exhibits which brought out into strong relief the work of the individual inventor, which lies at the foundation of much, if not all, of our present achievement. Prominent among such personal exhibits was that of Mr. Nikola Tesla, whose apparatus occupied part of the space of the Westinghouse Company.

This apparatus represents the results of work and thought covering a period of ten years. It embraces a large number of different alternating motors and Mr. Tesla's earlier high frequency apparatus. The motor exhibit consisted of a variety of fields and armatures for two, three and multiphase circuits, and gave a fair idea of the gradual evolution of the fundamental idea of the rotating magnetic field. The high frequency exhibit included Mr. Tesla's earlier machines and disruptive discharge coils and high frequency transformers, which he used in his investigations and some of which are referred to in his published papers.

Our engraving, Fig. 1, shows a view of part of the exhibits containing the motor apparatus. Among these there is shown at A a large ring which is intended to exhibit the phenomena of the rotating magnetic field. The field produced was very powerful and exhibited striking effects, revolving copper balls and eggs and bodies of various shapes at considerable distances and at great speeds. This ring was wound for two-phase circuits, and the winding was so distributed that a practically uniform field was obtained. This ring was prepared for Mr. Tesla's exhibit by Mr. C. F. Scott, electrician of the Westinghouse Electric and Manufacturing Company.

A smaller ring, shown at B, was arranged like the one exhibited at A but designed specially to exhibit the rotation of an armature in a rotating field. In connection with these two rings there was an interesting exhibit shown by Mr. Tesla which consisted of a magnet with a coil, the magnet being arranged to rotate in bearings. With this magnet he first demonstrated the identity between a rotating field and a rotating magnet, the latter, when rotated, exhibiting the same phenomena as the rings when they were energized by currents of differing phase. Another prominent exhibit is a model illustrated at C which is a two-phase motor, as well as an induction motor and transformer. It consists of a large outer ring of laminated iron wound with two superimposed, separated windings which can be connected in a variety of ways. This is one of the first models used by Mr. Tesla as an induction motor and rotating transformer. The armature was either a steel or wrought iron disc with a closed coil. When the motor was operated from a two phase generator the windings were connected in two groups, as usual. When used as an induction motor then the current induced in one of the windings of the ring was passed through the other winding on the ring and so the motor operated with only two wires. When used as a transformer the outer winding served, for instance, as a secondary and the inner as a primary. The model shown at D is one of the earliest rotating field motors, consisting of a thin iron ring wound with two sets of coils and an armature consisting of a series of steel discs partly cut away and arranged on a small arbor.

At E is shown one of the first rotating field or induction motors used for the regulation of an arc lamp and for other purposes. It comprises a ring of discs with two sets of coils having different self-inductions, one set being of German silver and the other of copper wire. The armature is wound with two closed circuited coils at right angles to each other. To the armature shaft are fastened levers and other devices to effect the regulation. At F is shown a model of a magnetic lag motor; this embodies a casting with pole projections protruding from two coils between which is arranged to rotate a smooth iron body. When an alternating current is sent through the two coils the

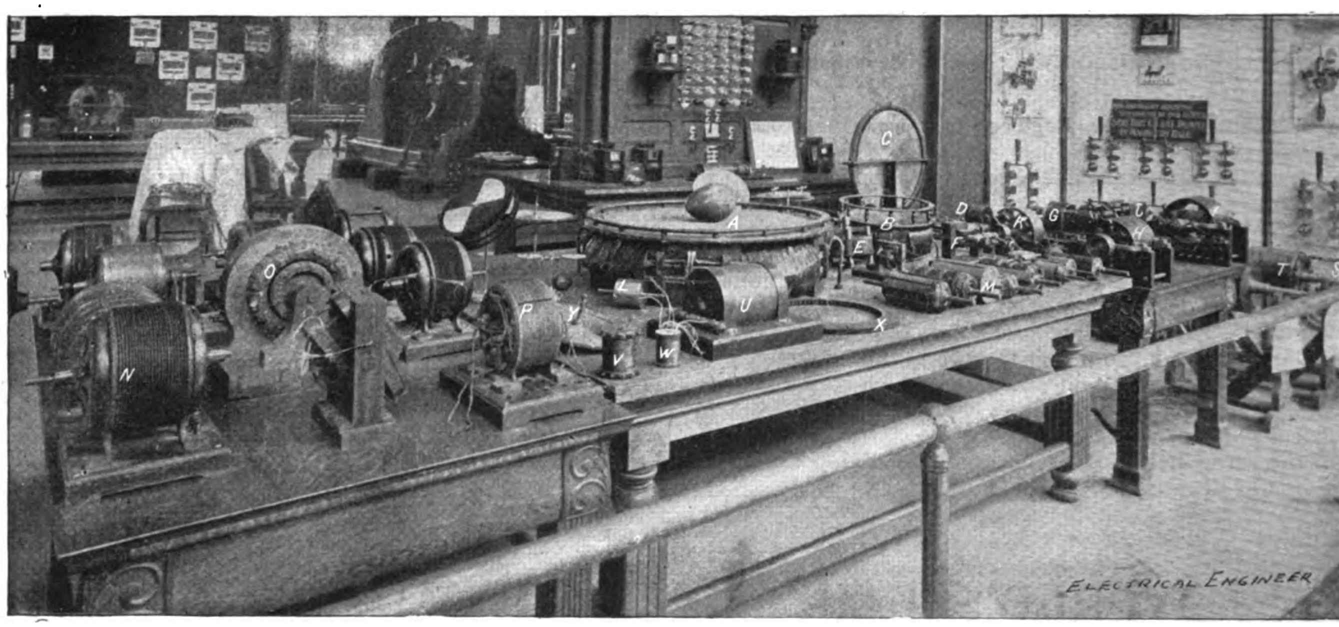
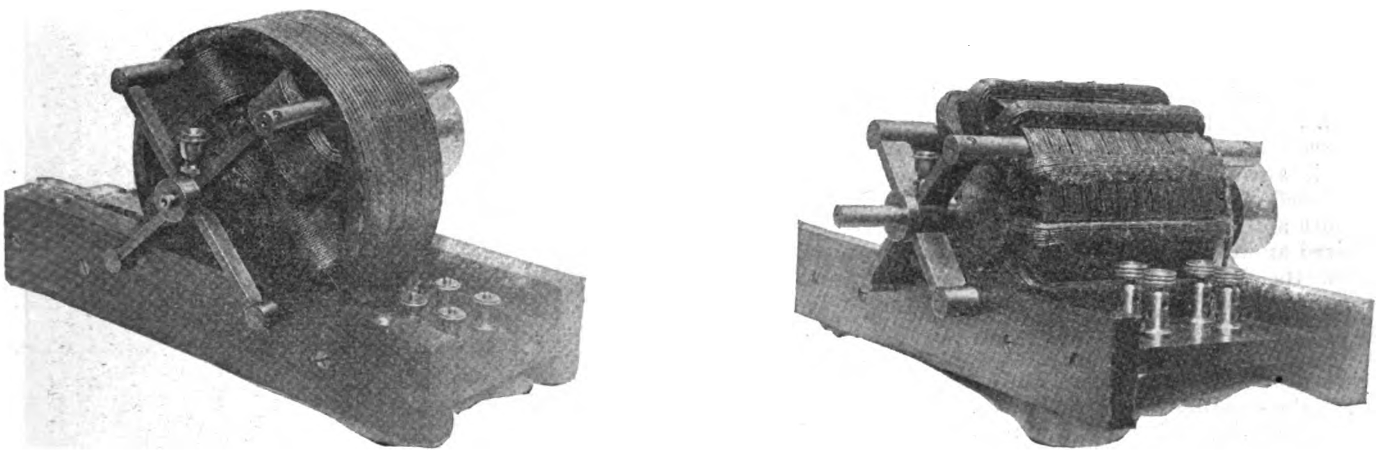


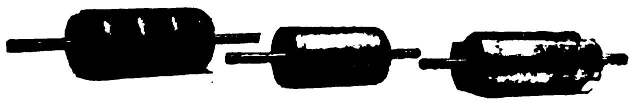
FIG. 1.—MR. TESLA'S PERSONAL EXHIBIT AT THE WORLD'S FAIR.

pole projections of the field and armature within it are similarly magnetized, and upon the cessation or reversal of the current the armature and field repel each other and rotation is produced in this way. Another interesting exhibit, shown at G, is an early model of a two field motor energized by currents of different phase. There are two independent fields of laminated iron joined by brass bolts ; in each field is mounted an armature, both armatures being on the same shaft. The armatures were originally so arranged as to be placed in any position relatively to each other and the fields also were arranged to be connected in a number of ways. The motor has served for the exhibition of a number of features ; among other things, it has been used as a dynamo for the production of currents of any frequency between wide limits. In this case the field, instead of being energized by direct current was energized by currents differing in phase, which produced a rotation of the field ; the armature was then rotated in the same or in opposite direction to the movement of the field and so any number of alternations of the currents induced in the armature, from a small to a high number, determined by the frequency of the energizing field coils and the speed of the armature, was obtained.

The models H, I, J, represent a variety of rotating field synchronous motors which are of special value in long distance transmission work. The principle embodied in these motors was enunciated by Mr. Tesla in his lecture before the American Institute of Electrical Engineers, in May, 1888. It involves the production of the rotating field in one of the elements of the motor by currents differing in phase and energizing the other element by direct currents. The armatures are of the two and three phase type. K is a model of a motor shown in an enlarged view in Fig. 2. This machine together with that shown in Fig. 3 were models exhibited at the same lecture, in May, 1888. They were the first rotating field motors which were independently tested, having for that purpose been placed in the hands of Prof. Anthony in the winter of 1887–88. From these tests it was shown that the ef-



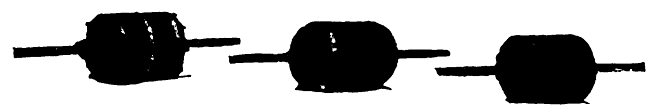
FIGS. 2 AND 3.—TESLA ROTATING FIELD MOTORS EXHIBITED IN HIS LECTURE BEFORE THE A. I. E. E., May, 1888.



FIGS. 4, 5 AND 6.

ficiency and output of these motors was quite satisfactory in every respect.

It was intended to exhibit the model shown in Fig. 3 but it was unavailable for that purpose owing to the fact that it was some time ago handed over to the care of Prof. Ayrton in England. This model was originally provided with twelve independent coils ; this number, as Mr. Tesla pointed out in his first lecture, being divisible by two and three, was selected in order to make various connections for 2 and 3-phase operations, and during Mr. Tesla's experiments was used in many ways with from 2 to 6 phases.



FIGS. 7, 8 AND 9.

The model, Fig. 2, consists of a magnetic frame of laminated iron with four polar projections between which an armature is supported on brass bolts passing through the frame. A great variety of armatures was used in connection with these two and other fields. Some of the armatures are shown in front on the table, Fig. 1, and several are also shown enlarged in Figs. 4 to 14. An interesting exhibit is that shown at L, Fig. 1. This is an armature of hardened steel which was used in a demonstration before the Society of Arts in Boston, by Prof. Anthony. Another curious exhibit is shown enlarged in Fig. 5. This consists of thick discs of wrought iron placed lengthwise, with a mass of copper cast around them. The discs were arranged longitudinally to afford an easier starting by reason of the induced current formed in the iron discs, which differed in phase from those in the copper. This armature would start with a single circuit and run in synchronism, and represents one of the earliest types of such an armature. Fig. 9 is another striking exhibit. This is one of the earliest types of an armature with holes beneath the periphery, in which copper conductors are embedded. The armature has eight closed circuits and was used in many different ways. Fig. 8 is a type of synchronous armature consisting of a block of soft steel wound with a coil closed upon itself. This armature was used in connection with the field shown in Fig. 2 and gave excellent results.

Fig. 6 represents a synchronous armature with a large coil around a body of iron. There is another very small coil at right angles to the first. This small coil was used for the purpose of increasing the starting torque and was found very effective in this connection. Figs. 10 and 12 show a favorite construction of armature; the iron body is made up of two sets of discs cut away and placed at right angles to each other, the interstices being wound with coils. The one shown in Fig. 12 is provided with an additional groove on each of the projections formed by the discs, for the purpose of increasing the starting torque by a wire wound in these projections. Fig. 11 is a form of armature similarly constructed, but with four independent coils wound upon the four projections. This armature was

used to reduce the speed of the motor with reference to that of the generator. Fig. 4 is still another armature with a great number of independent circuits closed upon themselves, so that all the dead points on the armature are done away with and the armature has a large starting torque. Fig. 7 is another type of armature for a four-pole motor but with coils wound upon a smooth surface. A number

FIGS. 10, 11 AND 12.

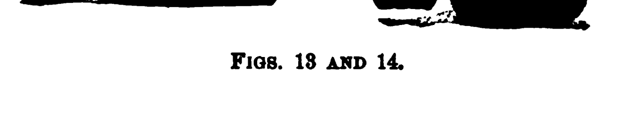
of these armatures have hollow shafts, as they have been used in many ways. Figs. 13 and 14 represent armatures to which either alternating or direct current was conveyed by means of sliding rings. Fig. 13 consists of a soft iron body with a single coil wound around it, the ends of the coil being connected to two sliding rings to which usually direct current was conveyed. The armature shown in Fig. 14 has three insulated rings on a shaft and was used in connection with two or three phase circuits.

All these models shown represent early work, and the enlarged engravings are made from photographs taken early in 1888. There is a great number of other models which were exhibited, but which are not sharply brought out in the engraving Fig. 1. For example at M is a model of a motor comprising an armature with a hollow shaft wound with two or three coils for 2 or 3-phase circuits; the armature was arranged to be stationary and the generating circuits were connected directly to the generator. Around the armature is arranged to rotate on its shaft a casting forming six closed circuits. On the outside this casting was turned smooth and the belt was placed on it for driving with any desired appliance. This also is a very early model.

On the left side of the table there is shown a large variety of models, N, O, P, etc., with fields of various shapes. Each of these models involves some distinct idea and they all represent the gradual development chiefly interesting as showing Mr. Tesla's efforts to adapt his sysem to the existing high frequencies.

On the right side of the table, at S, T, are shown, on separate supports, larger and more perfected armatures of commercial motors, and in the space around the table a variety of motors and generators supplying current to them was exhibited.

The high frequency exhibit embraced Mr. Tesla's first original apparatus used in his investigations. There was exhibited a glass tube with one layer of silk covered wire wound at the top and a copper ribbon on the inside. This was the first disruptive discharge coil constructed by him. At U is shown the disruptive discharge coil exhibited by him in his lecture before the American Institute of Electrical Engineers, in May, 1891. At V and W are shown some of the first high frequency transformers. A number



FIGS. 13 AND 14.

of various fields and armatures of small models of high frequency apparatus is shown at X and Y and others not visible in the picture were exhibited. In the annexed space the dynamo used by Mr. Tesla at Columbia College was exhibited; also another form of high frequency dynamo used.

In this space also was arranged a battery of Leyden jars and his large disruptive discharge coil which was used for exhibiting the light phenomena in the dark room. The coil was operated at only a small fraction of its capacity as the necessary condensers and transformers could not be had and as Mr. Tesla's stay was limited to one week; notwithstanding, the phenomena were of a striking character. In the room were arranged two large plates placed at a distance of about eighteen feet from each other. Between them were placed two long tables with all sorts of phosphorescent bulbs and tubes; many of these were prepared with great care and marked legibly with the names which would shine with phosphorescent glow. Among them we noted some with the names of Helmholtz, Faraday, Maxwell, Henry, Franklin, etc. Mr. Tesla had also not forgotten the greatest living poet of his own country Zmaj Jovan; two or three were prepared with inscriptions, like "Welcome Electricians," and produced a beautiful effect. Each represented some phase of this work and stood for some individual experiment of importance. Outside the room was the small battery seen in Fig. 15, for the exhibition of some of the impedance and other phenomena of interest. Thus, for instance, a thick copper bar bent in arched form was provided with clamps for the attachment of lamps, and a number of lamps were kept at incandescence on the bar; there was also a little motor shown on the table operated by the disruptive discharge.

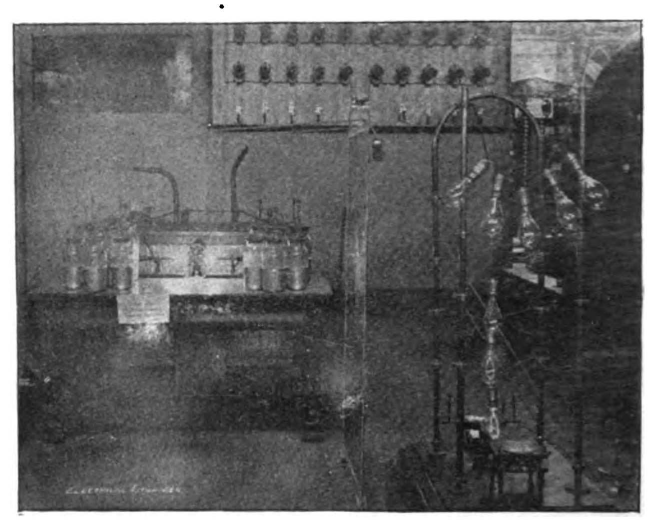


FIG. 15.

As will be remembered the Westinghouse Company made a fine exhibit of the various commercial motors of the Tesla system and also the twelve generators in Machinery Hall were of the two-phase type constructed for distributing light and power. Mr. Tesla, as is also known, exhibited some models of his oscillators. It was Mr. Tesla's intention to exhibit his motor and high frequency apparatus only during the Congress week, but it was allowed to remain on exhibition on account of a generally expressed desire. Furthermore as Mr. Tesla had only a week's notice to prepare his lecture all his time was taken up for this purpose, otherwise his motor, and especially his high frequency, exhibit would have been more complete.

THE FAIR IN '94.

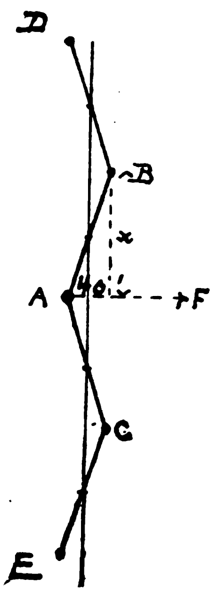
THE South Park Board of Commissioners of Chicago held a joint meeting with the executive committee of the World's Fair directory recently and decided to accept the Fair buildings and a sum of money sufficient to keep them in repair for some time. The state buildings and many of the foreign buildings will be removed. The park will be improved, and next season there will be electric displays, fireworks, etc. All the buildings will be open and the walks and roadways will be kept in perfect condition.

ELECTRIC RAILWAY DEPARTMENT.

THE STRAIN ON ELECTRIC RAILWAY POLES.

BY

R. C. Hull —



In an article by Mr. John C. Henry in your issue of Nov. 1, he states that the strain on electric railway poles would be reduced by the use of his proposed "diagonal" system of overhead construction. I submit the following as tending to show just what the strains would be—under different conditions.

In the accompanying sketch of a line such as is proposed, let A, B, C, D, E, be the poles and let x be one-half the distance between B and C. Let w_f be the weight of feeder in lbs. per ft. and let w_t be the weight of trolley. The strains on the pole A are along the lines A B and A C, and can be resolved into two equal and opposite strains along the line D E; and into two equal strains along the line and in the direction A F perpendicular to D E which correspond to the strain due to the trolley wire in ordinary span construction.

The strain along the line A B due to the weight of the feeder is

$\frac{AB}{2} w_f$ and that due to the trolley is $\frac{x}{2} w_t$;

and the resultant strain along the line A F will be

$$\frac{AB}{2} w_f \times \frac{40}{AB} + \frac{x}{2} w_t \times \frac{40}{AB}; \text{ or } 20 w_f + \frac{20\, x\, w_t}{\sqrt{x^2 + 1600}}.$$

In this case $x = 120$, and multiplying by 2 the total strain becomes, $S = 40\, w_f + 38\, w_t$.

It will thus be seen that the resultant strain due to the feeder is not dependent on the distance between the poles.

For ordinary span construction, allowing 6 lbs. for weight of span wire $S = \frac{w_t x}{2} + 3$; or, $S = 60\, w_t + 3$.

Now let us see what the strains would be for single and double trolley, using No. 00, No. 0000, and two No. 0000 wires for feeders.

Single Trolley.—Diagonal Construction.

No. 00 feeder	$w_f = .5$;	$w_t = .32$;	$S = 32.5$ lbs.
No. 0000 feeder	$w_f = .8$;	$w_t = .32$;	$S = 44.5$ "
2 No. 0000 feeders	$w_f = .16$;	$w_t = .32$;	$S = 76.5$ "

Single Trolley.—Ordinary Span.

$w_t = .32$; $S = 22.2$ lbs.

To find the equivalent distances between poles on ordinary span construction—equate $\frac{w_t x}{2} + 3$ to the different values of S in diagonal construction, and we get:

Single Trolley.—Ordinary Span.

No. 00 feeder	$x = 184$ feet;	number of poles,	58 per mile.
No. 0000 feeder	$x = 253$ "	"	42 "
2 No. 0000 feeders	$x = 460$ "	"	24 "

Double Trolley.—Diagonal Construction.

No. 00 feeder	$w_f = .5$;	$w_t = .64$;	$S = 45$ lbs.
No. 0000 feeder	$w_f = .8$;	$w_t = .64$;	$S = 57$ "
2 No. 0000 feeders	$w_f = .16$;	$w_t = .64$;	$S = 89$ "

Double Trolley.—Ordinary Span.

$w_t = .64$; $S = 41.4$ lbs.

No. 00 feeder	$x = 131$ feet;	number of poles,	80 per mile.
No. 0000 feeder	$x = 168$ "	"	64 "
2 No. 0000 feeders	$x = 268$ "	"	40 "

It will thus be seen that in no case is the strain on the poles in the diagonal system less than that in the ordinary span construction, and as the weight of the feeder increases, the strain increases to such an extent as to prohibit the use of the former system.

TROLLEY ACCIDENTS.

BY

L. Gutmann.

Noticing the discussion in regard to the trolley system and especially the remarks of Mr. E. H. Johnson, I would like to comment on some statements as they are adapted to deflect the cause of the trouble from its true source. In a complicated question like this, it is surprising to learn that the trouble is due to the electric machines or the electrical manufacturers, and that the street railway companies and motormen, and nobody else, are to blame. It is well known that generally the contracting company orders the electrical equipment from one firm, the truck from another and the car body from a third. Therefore, it seems to me there are five factors to be considered: 1, the street railway company; 2, the electrical company; 3, the truck builder; 4, the car body manufacturer, and 5, the man who operates the car.

Now, to my knowledge, not a single electrical concern, building car equipments has anything to do with the trucks or brakes and any complications due to them cannot be laid at their doors. On the other hand there have never been electric cars operated which have not been provided with means of reversing the cars. Further, since all armature conductors have been placed in the iron core and have, therefore, a suitable bearing or support, a sudden change of lines of force cannot change their position mechanically and the armature has become very reliable. In fact we may safely assume that present methods of construction of electric motors can fully do the work for the present. While we are living in a state of evolution, we all remember well that some years back 10 h. p. motors were used and did their work, but since the public has recognized the many advantages of electric propulsion, greater demands were made and engineers have kept right up to the times, so that the 10 h. p. has been superceded by those of 15, 20, 25, 30 and 50 h. p. motors.

A difference exists, however, in regard to the brakes. At first the ordinary horse car trucks were retained and the motors mounted on the axles, and, of course, the old hand-brake remained. As time progressed, the trucks were modified and the car bodies made larger. As regards strength they are sufficient for the new mode of propulsion; as regards control there is something still to be desired. The brakes and brake shoes may be sufficient, as they are on many roads, provided they are properly taken care of; they are but very seldom carefully inspected. To be sure, there is continual attention given to the brakes by men who have to inspect the cars, but all the changes made are temporary makeshifts. It is to be expected, that with this rapid transit the necessity has been felt of quickly bringing a car to a stand-still and naturally several inventors have constructed powerful brakes. There are four or five on the market now and the most familiar one is in daily use on many cable roads. That they are not applied to all the cars of a company is but natural. First, they want to test their efficiency; second, it involves an outlay of from $5,000 to $20,000. In many cases one or the other construction would be objectionable, due either to the construction of the car body or else to the apparatus below the same. Even admitting that a company had the choice between two or three good brakes which now exist, it would be too much to expect that a company should change the car bodies for the sake of placing a brake, or to make other complicated changes.

But there are other means of remedy which are certainly within the reach of railroad companies. They are the selection as a superintendent of an electrical engineer for a road operated by electric power and by the employment of proper men who have received instructions. I have called attention to this fact in a paper prepared for the Cleveland Street Railway Convention.[1] In that paper I have called attention to the necessity of creating a new profession by instructing motormen to be for the electric motor what an engineer is for his engine. Striking in this respect are the words of Mr. Johnson when he says: "Were any other power employed to propel the car, independent of horses, the

1. "Bucking of Motors," *Street Railway Review*, November, 1892.

result would be the same if *subject to no better control*. The qualification is important, as it is therein we shall accurately and justly locate the responsibility and, mayhap, discover the remedy for the evil."

The answer we find also in Mr. Johnson's article. He says: "An analysis of the fifteen fatal accidents reported in August discloses the pregnant and pertinent fact that in eleven of them it was proved that the motormen could not manage the car."

I can make the statement more complete by saying that 80 per cent. of the motormen operating the electric cars do not understand anything about the motors and about what they are doing other than turning a handle.

Mr. Johnson is perfectly correct; if the cars were controlled intelligently, certainly the number of these many accidents would have been reduced considerably. It will be observed that I have changed the interpretation of his phrase, because any good tool placed in the hands of a poor mechanic will result in his not only spoiling the work, but also the tool which he does not understand; but the blame is invariably thrown on the tool.

Further on he makes the logical remark: "Were that what it should be, the very power employed to propel the car could and would be called into requisition to overcome its impetus as in a steam locomotive. Why is it not?"—The fact is, that every electric car is provided with means of electrically stopping a car, by means of a reversing lever or by means of the controlling stand. A further fact is that a locomotive engineer knows every part of his engine, can readily detect any irregularity of operation and knows beforehand the results of any move he makes with his controlling levers. Why it is not done and used by motormen is simply because they have never been instructed. It is just this difference between a motorman and locomotive engineer.

Now I wish to mention but two facts. 1. I have found that even after instructing motormen in the use of controlling stand and levers, they knew that one motion would cause the car to go forward and by reversing they could propel the car backwards, but this is by no means enough. They are not engineers nor electricians and cannot be expected to make the logical conclusion that they could use this reversing method as a brake; this I had not only to explain, but even to show before some of them could follow the idea. 2. A certain railway company insisted on the application of a latch to the controlling lever of an electric car so as to prevent the reversing of the current and motion of the car. The idea was opposed on the ground that in case of danger, the lever can never be thrown over too quickly. The reply was, that danger and accidents may not happen in years while a motorman may accidentally do it some six times a day and more. The latch was placed. At the time, all men were instructed; but, as is natural, changes will occur. Four months later I read of an accident at a railroad crossing with this very car because the motorman did not know that by pressing a button of the size of a dollar under his controller lever and within easy reach of either hand or knee, the handle could be reversed. He had never been instructed. "That is why the very power employed to propel the car could not be, and was not, called into requisition to overcome its impetus."

Such non-instruction is criminal neglect on the part of the company or their superintendent, and here I wish to call attention to some other points perhaps not generally known. A company is responsible for a good many accidents because they can be avoided by proper selection of the employé. If a superintendent is a good electrician and also a machinist or practical mechanical engineer, he will not be afraid to teach or instruct his men. Many superintendents now are opposed to any such instruction because a man of his force may gain as much knowledge (or as little) as he himself possesses, and thereby endanger his position. There is no need for such a state of affairs; there are now plenty of engineers competent to take charge of such a position, the times of a few years ago when such people could not be secured have passed.

Another point is the selection of the men themselves. Some companies do not choose very much and I have found motormen so rough that I would hardly give them room to ride in the car, much less intrust it and its passengers to their careless and even reckless disposition. They are by no means *all* keenly alive to the ever-present liability to do mortal injury to their fellow men, and, it may be said, fortunately, that there is but a very small percentage that does not even care, because the people should look out; they would immediately be ready with the answer, that they could not control the car.

I have found that the best motormen are those of ordinary size, not exceptionally powerful men, of a mechanical turn of mind. They are willing to learn because they know that their muscular strength alone is not enough to control the car. Considering, however, a sturdy laborer, he has all the confidence in his powerful arms and to begin with unknowingly (having no judgment), strains brake chain, gears, key seats, etc., until he knows what he is doing. If he does not care for his position later on, or is of a reckless disposition, he makes use of the reversing lever instead of his brake as this would mean less bodily work. It may be mentioned that superintendents having a good deal of repair on their road for which they may hitherto not have been able to account may find such a practice to prevail.

In my opinion the responsibility of a motorman is greater than that of a locomotive engineer because in the latter case the road over which he travels is for the greatest part free from pedestrians; he has therefore only to take care of his passengers, while the former has besides these to consider that citizens and carriages have a right on the highway. The blame cannot in many cases be put on the uninstructed motorman of to-day nor on the manufacturers supplying a part of the equipment of a car, but the greater part of the responsibility rests with the company or their superintendent in so far as it relates to neglect in performing their duty toward public safety. Of course they cannot be held responsible for every accident, as even under the best organization any class of machinery may give out unexpectedly.

TROLLEY ACCIDENTS, THEIR CAUSES AND MEANS OF PREVENTION.

BY JOS. E. LOCKWOOD.

THE ELECTRICAL ENGINEER in calling particular attention to the causes of trolley accidents, and in starting and encouraging discussion as to their causes and means of prevention has certainly called attention to that particular feature of electric street railroading which, more than any other to-day, demands the attention of manufacturer and investor, and it is to be sincerely hoped that the discussion resulting from the ENGINEER'S call will have some practical result. That, from the standpoint of mechanical construction and electrical efficiency there has been a really wonderful progress made in this branch of the electrical field, since the time but a few years past when the first practical electric street railroad was put into operation, no one can for a moment deny; and this progress when taken in connection with the rapid and unparalleled growth of the business, stands, I believe, as a record which not only has never been equalled, but which is beyond the possibilities of any combination except that of electricity when joined with American genius and enterprise. It is not, therefore, to be expected, that a work produced under such stress and improved so rapidly should be in every particular up to the possibilities, but we are now at a point where we can with great advantage do as THE ELECTRICAL ENGINEER suggests, and by carefully reviewing the shortcomings of the present system and apparatus, and ascertaining the causes thereof, make such changes as will not only add another to the long list of advantages now universally acknowledged to be the exclusive property of electricity, but by doing away with the greatest objection now brought against its use for street car service, extend the field of its operations, and thus benefit not only this branch of the electrical field, but every branch of applied electricity as well,—for the success of each helps all others.

Now, as regards first the cause of trolley accidents, there is no doubt that many classed by the public press under this heading have in some cases not been such at all, while in others they have been attributable to the carelessness and faults of others than the street railway companies and their employés. Accidents have, however, unquestionably occurred that could have been avoided if the cars could only have been stopped within a few feet after discovering the danger, or even in some cases within a few car lengths. To realize this fully, and to ascertain at the same time the probable cause of many of these accidents, we need but to examine the article published in the *New York Herald* as referred to in the editorial in the ENGINEER of September 27, 1893. In this article, outside of those accidents that are not described, there are 35 specifically described, which can be grouped as follows:

Collisions between electric cars and other vehicles	12
Persons struck or run over by electric cars	10
Collisions between two electric cars	4
Persons hurt otherwise than by electric cars	4
Persons hurt getting on or off electric cars	3
Persons hurt by sudden stoppage of electric cars	1
Persons hurt by trolley falling	1
Total	35

The first three of these groups, aggregating 26, or over two-thirds of all, it will be seen, if correctly reported, may properly be termed "Trolley Accidents"; the remainder, however, were either not trolley accidents at all, or not really such in the true sense of the word. It is then to the first three mentioned groups that our attention should be confined. What proportion of the 26 accidents included in these groups were unavoidable it is impossible to say. It is, however, but reasonable to conclude that at least a portion of them could have been prevented had it been possible for the motormen to stop their cars within a few feet after discovering the danger. We are, therefore, I think, justified in the conclusion that the principal cause of such accidents as might have been prevented lay in "imperfect control" of the electric cars, and consequently let us now see what can be done to improve the control.

As all practical methods of starting, running and stopping electric cars, with the exception of track brakes sometimes used in stopping but not generally found satisfactory, depend for the accomplishment of their ends entirely upon the traction of the

car wheels on the rails, it is obvious that to obtain the best possible results we must first obtain the greatest possible utilizable traction, consequently as steam locomotive practice has thoroughly demonstrated how this should be done, namely, *by coupling all driving wheels together*, we should profit by their experience and couple our axles together *so that all car wheels must move in unison*. We can then rely upon utilizing every particle of traction due to the weight of truck, motor, car body and load, irrespective of how unequally this weight may be distributed on the different wheels. As much depends upon our doing this, let anyone who doubts the *necessity* of doing so, take a single truck equipment with axles separately driven, and try for himself the experiments of, first, starting as quickly as possible a heavy car on a slippery track; second, reversing the current while the car is moving forward at the rate of 10 to 20 miles per hour with a view to stopping the car as quickly as possible; and third, stopping the car when it is running at a good speed in the shortest distance possible by the use of the hand brakes, and when making these experiments note carefully the movements of the car wheels on different axles. I think the difference in movement that will be noted between the wheels on different axles will convince anyone who is unprejudiced *of a lack of united effort* and will thus convince him of the necessity of this first step.

Now, to utilize the traction to the best advantage we should not apply the motive power to the car wheels instantly, as that is likely to cause slipping and thus to reduce the traction and defeat the end sought; it being a well known fact that the slipping of a car wheel reduces greatly its traction, consequently the power should be *gradually applied*, even though the time of this graduation be comparatively short. The starting of a heavy freight train on a steam road illustrates this fact, as in doing this the engineer is obliged to start his locomotive slowly so that the driving wheels will get the best possible traction; in case the driving wheels do slip he is obliged to either uses and or cut off the steam until the slipping has stopped and the drivers have regained their grip on the rails. This advantage can be obtained in applying our electric power to the car wheels, by using between the motor and axle some yielding device, and in obtaining this we will also be removing the possibility of mechanical shocks being communicated from car wheels to gearing and motor, and thus not only protect them from damage but also lengthen their life,

We now come to the motor itself, which should be of ample power and of a type of construction that can be depended upon, not only to fulfill the requirements of ordinary service, but also to stand reversals of current, even when cars are running forward at full speed and carrying heavy loads, without the possibility of break-down or damage, as upon its ability to stand even these excessive strains, depends entirely the quick stopping of the cars by means of the motor. This feature is the most important one, as by accomplishing it we not only prevent heavy expenses in the matter of repairs by preventing breakages, but also, what is much more important, are enabled to avoid many accidents and their attendant expenses and troubles. This requirement I am satisfied is not inconsistent with economy of design and operation.

We now come to the control of the current actuating the motor, which chiefly depends upon the controlling switches. In controlling switches as great improvements have undoubtedly been made as in any other appliance connected with electric equipments, if we judge entirely from the standpoint of electrical efficiency; but if we judge from the standpoint of simplicity of construction, and convenience of control, the same cannot be said, as many of the latest types are not only extremely complicated in construction, but, what is a much more serious matter, *cannot be reversed quickly and conveniently*. The complication is not only objectionable on account of its necessitating the keeping in repair of many parts, but also for the reason that if any one of these parts fails to perform properly its function it is likely to disable the whole switch.

The impossibility of reversing quickly these late types of controlling switches is, however, their greatest drawback, and this is due to their being so constructed that *two* handles have to be used to reverse them, thus necessitating a complex and awkward movement. In this drawback, I believe, lies the greatest single cause of imperfect control, and I am firmly convinced that what we should have is *one handle only to control the electrical equipment of a car*, and that one so arranged that by *one continuous and natural movement*, the current could be turned on and graduated, or turned off and reversed. Then, in case a collision was imminent and its prevention depended upon the reversal of the current without the loss of even an instant of time, there would be a probability of its being prevented; but as long as the movement required is a complex one there is but little chance of its being properly made at times when it is but natural for the motorman to act without stopping to think.

I, however, do not think that the electric motor should be used for the purpose of stopping the car *except in an emergency*, as hand brakes can unquestionably meet all ordinary requirements in the proper manner. It would, therefore, be not only a waste of current but an unnecessary wear and tear upon the motor, gearing, etc., if this were done. Reviewing now the conclusion reached we have:

1. Both axles of a car truck should be coupled together so that all wheels must move in unison.
2. Some yielding device should be used between motor and axles to admit of gradually applying the power.
3. A motor should be used that will stand reversals of current even under extremely severe conditions without possibility of breakdown.
4. Controlling switches should be as simple in construction as possible and operated entirely by one handle, so arranged as to allow of turning on and graduating or turning off and reversing, the current, by one continuous and natural movement.

In conclusion. I would suggest that this matter should not be left to the manufacturers of electrical apparatus, for them to pass on the suggestions made and adopt or reject them as they might think best from their standpoint, as some would naturally object to the expensive changes of patterns, tools, etc., that might be required, others might be influenced by the ownership of patents, and still others by the fact that they might have "an axe to grind." But let the street railway companies themselves, say whether or not these or any other improvements suggested are to be adopted, as, if they demand certain improvements and firmly refuse to accept anything less, there is no question but that apparatus conforming to their demands will be forthcoming.

TROLLEY ACCIDENTS.

THERE is no doubt that you have hit the nail on the head in working up this subject just now, yet almost all ideas as to *the* brake required must be speculative.

It seems to me that the latest improved ratchet brakes are about as good as could be got when we consider every feature in the light of actual economy. The air brake is too expensive and unreliable, especially in the hands of the ordinary motorman. The friction-cone brake is cumbersome and impracticable for electric cars. Bring on your electric brakes; anything "electrical" is bound to *go*!

Before even this brake question is finally settled, the public must distinguish between urban and interurban transit, and decide where the high-speed lines shall be run. It is out of the question to think of getting a brake that can, within a few feet, stop cars that have attained a great speed. If we had such a brake in use our rolling stock would be torn to pieces in a very short time, and very probably there would be more people killed than now through the carelessness that overconfidence in such apparatus would cause in motormen and public alike. I believe that until better provision is made in the streets for the requirements of rapid transit, it will be found wasteful and unsatisfactory to experiment with any expensive brakes. The biggest leak for the nickels at present comes from the fact that the motormen are not taught how to operate their cars properly.

LUCIUS E. MARPLE.

MONTREAL, CAN.

I REGRET that lack of space or other considerations caused "Doctor" Johnson to give so short a review of my paper on the above subject as to render that review misleading, and I feel sure that other contributors must feel the same regarding the extracts that appear in the issue of THE ELECTRICAL ENGINEER, of October 25.

As the man with a "system" is apt to think more of his own than of anyone else's ideas, it may be excusable for those who believe in the solution of the problem by perfect motors, the simplest and surest form of control and improved methods of braking, to retain their doubt as to the feasibility of requiring a motor to fill its own and many other functions, until this remarkable result is satisfactorily accomplished in actual practice.

GILBERT WILKES.

DETROIT, MICH.

ELECTRIC RAILWAY PLANS IN NEW ENGLAND.

THE project for an electric railroad between Haverhill and Manchester is taking shape. Promises of financial support have been given and committees appointed to procure plans and estimates. The plans thus far developed are for two lines between Haverhill and Manchester, one via Atkinson, Hampstead, Chester and Derry, and the other via Ayers Village, Salem, Windham and Hudson to Nashua, where it will connect with a proposed line to Manchester. The scheme is one of the largest street railway projects yet broached, including over 60 miles of road.

A JACKSONVILLE, Florida, newspaper makes the following offer, which seems fair enough to be accepted: "If somebody will only give us a line of trolley cars on Bay street we will agree to suppress for a term of years all pleasantries upon the much-abused system."

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THE FUNCTION AND USES OF PUBLIC PARKS.

AMERICAN cities do not yet give any evidence of clearness and certainty in their opinion upon the proper function and uses of public parks. This may be due to the fact that very few people have any definite idea as to what a park is or should be. Most of us can express some convictions as to what it should not be. We do not want to see it a parade ground or a speedway; we do not wish to see it a place with shows from end to end, whose attractions to a noisy crowd equal those of a Bowery. On the other hand, few of us, perhaps, go as far as did the late Frederick Law Olmstead, whose landscape gardening was broad as nature's own, and who, in reality, if we may judge by results, cared little even for flowers, when he could preserve the distinct beauty of wide lawns and deep masses of foliage. There is a general liking for bright flower beds, for the animated aspect of a well-frequented pleasure ground, for music under the trees, and for the innocent amusements that recreate and invigorate; but these cannot be found in mere solitude.

Twice during the past week questions of importance have arisen as to the use of electricity in supplementing and amplifying the pleasure resources of Central Park, and the points at issue are of interest as much to electrical engineers as to the public of New York City. It is proposed, first of all, to light the drives in the Park with incandescent lamps, and work is about to begin. The experiment is worth watching. It will give to many people a quiet use of the Park that they cannot now get, on account of their employment in the day time, and it will make certain portions of the Park very beautiful at night. Some of our readers will remember how fine and entrancing was the effect similarly produced around the lawns and parterres at the Paris Exposition in 1889. But for the objections of Mr. Olmstead and his staff, some of the beds flanking the Court of Honor at the World's Fair would have been treated thus, with considerable gain in the night beauty of that wonderful spot. Our only doubt is as to the adequacy of incandescent lighting for the work, but we are prepared to find the fear agreeably disappointed. Washington Park, in Chicago, and others elsewhere, have, it may be mentioned, arc lighting along the drives.

The other question now up is as to the installation of an electrical fountain in the Park, and an advantageous offer has been made to the Commissioners of one of the celebrated Stieringer fountains from the World's Fair. Now nothing is more certain than that those fountains, built for a specific place and purpose, are little desirable for any position in the Park. It would be better to build a new one, even if it cost a great deal more money; and just what kind of a fountain that would be must be determined be expert consideration of all the elements of accessibility, availability of water pressure and supply, plenty of room for spectators, and the preservation of the natural features of the Park.

The growth of population in the upper part of the city has deprived Central Park of much of the seclusion that not many years ago was chief among its charms, and which means so much to lovers of Nature pent up in modern stony, roaring cities. Anyone loving Central Park who has read Matthew Arnold's lines written in Kensington Gardens has felt again the spirit of repose and rest that he there enjoyed, in the heart of London, "amid the city's jar," and "across the girdling city's hum;" and, inspired by the deep feelings he utters, has been swift to resent any proposition that would deprive our own glades and sheepfolds of their forest airs and their pastoral stillness. Yet there are many places in the Park to-day that are always populous, that the crowd haunts, and that might perhaps be utilized, without detriment and with genuine benefit, say once a week, for such a beautiful, fairy-like spectacle as an electrical fountain affords. The Court of Honor at the World's Fair was thronged nightly by multitudes whose one wish was to see the rainbow geysers play, and in the interviews had with distinguished visitors after the Fair, the unanimity of opinion reported as to the beauty of the scene was remarkable. Now such a sight might well be added to and counted among the free pleasures of dwellers in great cities; and in fact, the little electrical fountain at Lincoln Park, Chicago, is a never-ending source of delight to the dwellers on the Northside. If, then, we can have in Central Park such an addition to its attractions, without lessening any that are now so highly and so dearly prized, the plan should be adopted. It is not impossible that in one or two of the older, large city squares, good sites might be found, but they would be open to the objection of distance from some portion of the population.

As we have said, the question is one that concerns any large city, and it specially affects cities whose scanty Parks are much frequented. In New York we have fortunately immense areas of new, untrodden Park within easy reach, where romantic scenery like that of the Hemlock Grove can be found in absolute quiet, even on holidays. Hence the sacrifice, if such it be, of older, smaller parks already invaded by people who must take the air in big crowds because there is no other way of getting it, is not of so much moment as it may be in communities where the one Park is small and where straggling, mean suburbs cut off the lover of trees and grass from the true country lying beyond. It strikes us, also, that in many instances, the installation of such fountains must be determined by the practical problems already hinted at, and by those connected with the erection of a power plant for the work.

SIGNIFICANT LITIGATION.

From the point of view of electrical trade and industry not a little interest attaches to the patent case of Bate Refrigerating Company *v.*Sulzburger *et al.*to come up for hearing in the United States Circuit Court of Appeals,New York, some time in December. Our readers will doubtless recall the Bate case which made such a stir in 1889, and will perhaps remember that in its decision (printed in full in The Electrical Engineer of February of that year) the Supreme Court of the United States found it unnecessary to consider the contention of the Bate Company (appellant) that the language of the famous Section 4,887 of the Revised Statutes should be so construed as to free any American patent from limitation by the term of a foreign patent if the American application antedated the foreign, although the foreign *grant* was the earlier. On other grounds the Court held the Bate patent to be in force and that its life would be limited by the actual duration of Bate's Canadian patent [to January 9, 1892.] Bate's American application was earlier than his Canadian application. The judgment of an appellate court is now sought on the question that the Supreme Court omitted to deal with in 1889. The Circuit Courts have hitherto held the respective application dates of an American and a foreign patent for the same invention to be irrelevant, and that a prior foreign *grant* limited the life of an American patent.

The issue raised in the Bate-Sulzburger case is of obvious and weighty interest to the General Electric Company and to the American Bell Telephone Company, as well as to their competitors or opponents; each of those companies owning important patents the duration of which will be affected by the determination of the Bate case, viz., the Edison lamp patent of January 27, 1880, and the Edison telephone (carbon transmitter) patent of May 3, 1892.

It will be remembered that the Edison Electric Light Company took part in the Bate case of 1889 and that briefs were filed by counsel for the Westinghouse and other electric light companies. It would not be surprising if the same parties, and the Bell Company, were to take a hand directly or indirectly in the new Bate case before the Appellate Court next month. The telephone company would seem to have most at stake in view of the date of their patent, (applied for July 20, 1877, and issued only last year) which under the existing interpretation of section 4,887 would seem to have been void from its issue.

The case will be argued for the appellant by C. E. Mitchell, Esq., (who appeared for the Edison Company in the Oconto lamp case) and for the appellee by Hon. Rufus W. Peckham, of Miller, Dunham & Peckham.

WIRING AND INSULATION TESTS.

At the first glance it does not appear a formidable undertaking to keep a current at a potential of 110 or 220 volts confined within its proper path, but any one who has followed the changes and improvements that have been effected in insulators and electrical fittings will come to the conclusion that had the pioneers in electric lighting fully appreciated the difficulties which had gradually to be overcome in this direction, they would probably never have had the hardihood to adopt the potentials which have come to be the standard for low tension distribution. No better illustration of what precautions are required can be had than the stringent rules laid down by the fire underwriters who, from the very beginning of commercial electric distribution have been both its enemies and its friends,—its enemies in the frequently unreasonable nature of their demands, and its friends in that these very demands spurred the electrical engineer on to devise ways and means for securing perfect safety in wiring installations. The difference of opinion which exists, not only among insurance men but among electrical engineers also, as to what constitutes safety in electrical work, is well brought out in the table contained in Mr. J. Appleton's article on another page, in which are tabulated the various standards of insulation required by the leading electric lighting and fire insurance companies in London. The variations which are exhibited in this table are quite marked and the standards generally are higher than those required by the underwriters in this country. It is perhaps too much to expect that the ideas as to safety held by the underwriters and the electric lighting companies will coincide for some time to come, but the large concessions already made on the one side, together with the improved character of the work accomplished on the other, give grounds for hope that a uniform and generally acceptable set of wiring rules will be evolved at no very distant date.

OBITUARY.

ANTHONY RECKENZAUN.

It is with deep regret that we announce the death in London, on Nov. 11, of Mr. Anthony Reckenzaun. As an enthusiastic supporter of the storage battery for traction and navigation Mr. Reckenzaun has probably contributed more than any one else to bring the possibilities of the accumulator to the attention of the public, both technical and lay, and much of the practice obtaining in these fields to-day is due to him.

Mr. Reckenzaun was born in 1850, at Graz, in Austria, where he received a thorough technical education. He went to England in 1872, and obtained employment with a firm of marine engineers. In connection with their works he established evening classes for the benefit of employés, and gave lectures during three years on "machine construction and drawing" and "steam"; but in order to qualify himself according to the rules of the South Kensington Science and Art Department, he first underwent examination in those subjects, and passed with first-class honors. Subsequently he attended the courses of lectures given to qualify science teachers at the Royal School of Mines in 1877 and 1879, when he again obtained first-class at the final examination in steam and mechanics. On visiting the Paris Exposition of 1878, he resolved to devote himself to the study of electrical engineering, and he then devoted himself to this branch until at last he joined the Faure Accumulator Co., which he left, however, soon afterwards, and accepted the post of engineer to the Electrical Power Storage Co. There he designed the first electric launch, "Electricity," driven by means of storage batteries of the Electrical Power Storage Co., in 1882; and soon afterwards he made an electric tramcar which was publicly exhibited on the West Metropolitan Tramway in March, 1883. Mr. Reckenzaun gave numerous lectures and read papers on "Storage Batteries and Electric Locomotion" before scientific societies, notably the British Association, the Society of Arts, the American National Electric Light Association (when meeting in Boston, Mass.), the American Institute of Electrical Engineers (of which he was a member), and the Vienna Electro-Technical Society. The Society of Arts awarded him its silver medal for his paper on "Electric Locomotion." He has also written numerous articles for scientific journals. The English *Electrical Review* in particular has published many valuable contributions from his pen. He started business on his own account in 1885 for the purpose of building boats, cars, and electric motors for various purposes. The most noteworthy of the boats was the "Volta," which made the celebrated double voyage between Dover and Calais on the 13th of September, 1886, also the more difficult voyage between London and Dover. Mr. Reckenzaun spent nearly a year in the United States, when he introduced his electric cars on several tramways, and where he built the "Magnet" the first electric launch in American waters. He was an ardent advocate of secondary batteries, and has contributed largely to our knowledge of the subject. Among other work may be mentioned the Reckenzaun-Pentz meter, not long since described in these pages. He came over to this country again last summer to inspect the electrical exhibits at the World's Fair, and take in the general technical situation. Just before leaving New York, he was a guest more than once at the offices of The Electrical Engineer, where much concern was expressed at his evident ill-health. He was urged to give up work and visit some of the resorts in Southern Europe or the West Indies, but declined attempting to defeat fate, for he regarded himself as foredoomed. His death deprives the electrical engineering profession of a pure and noble spirit, and his friends of a manly, tender companion.

LEGAL NOTES.

THE FIELD RAILWAY CASE.

ONE of the most important suits ever brought before the Federal Courts of this country, in its relations to the electric railway industry, has just been argued before Judge Wm. K. Townsend in the U. S. Circuit Court in New York. It is claimed that should the complainant's contention be upheld, there is hardly an electric road but will be obliged to pay tribute to the owners of the patent sued on.

The case is that of the Electric Railway Company of the United States vs. The Jamaica and Brooklyn Road Company, for infringement of letters patent No. 407,188, granted July 16, 1889, to Stephen Dudley Field, for "Improvement in Electric Railways," which patent, by mesne assignments, is now the property of the complainant company. The counsel in the case are E. M. Marble, ex-Commissioner of Patents, and Edmund Wetmore, for the complainant; and Frederic H. Betts and H. W. Seely for defendant, with Messrs. Eaton & Lewis as solicitors for defendant.

The argument was opened on Nov. 15th by Mr. Marble, who occupied the attention of the Court until the 17th when he was followed by Mr. Betts, who spoke during a portion of the 17th, all of the 20th and a portion of the 21st. The closing remarks were made by Mr. Wetmore, who finished on the 22d.

Only one of the claims of the patent is involved in the suit, namely, the first, which is as follows:

> The combination, substantially as hereinbefore set forth, of a stationary dynamo electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railroad track, a wheeled vehicle movable upon or along said insulated section of track, an electromagnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit-controlling device placed upon said vehicle.

On May 21, 1879, Mr. S. D. Field filed in the Patent Office a caveat, in which he stated that he proposed to propel cars along tracks by means of electricity—

> "in substantially the following manner: I will station a dynamo-electric machine at some convenient point along the track, connecting the positive and negative wires of the machine with two of the rails, so they will serve as conductors. All the wheels on one side of the car I will insulate from their axles. On board the car I will place a secondary dynamo electric machine and gear it to one or both of the axles of the car. Now, if a current passing from the primary dynamo-electric machine at the central station along the rails or along a supplemental conductor attached to the rails, the secondary machine on board the car will be actuated and its power transmitted to the axles of the car for propelling it along the track. By using a suitable current reverser on the car, the direction of the current can be changed at will, so as to run the car in either direction. What I claim and desire to secure by caveat is the above described or similar method of propelling cars on tracks."

The Complainant's Contention.

On March 10, 1880, Mr. Field filed his application for letters patent upon which application the patent in suit was eventually granted. It is claimed on behalf of complainant that this invention was the result of twenty years of prior study and experiment on the part of Mr. Field in electricity, and that so far as appears by the records of the Patent Office, Mr. Field first disclosed therein the system and apparatus for the propulsion of cars by electricity as described in the patent in suit. The application was soon brought into interference with subsequently filed applications of Ernst W. Siemens, Thomas A. Edison, George F. Green and Thomas Hall, and the contest was conducted with a persistency seldom, if ever, equaled in the history of the Patent Office. In all of these interferences, Mr. Field was decided to be the first and original inventor of the subject matter thereof and particularly of the combination of elements in the first claim of the patent in suit. In 1883, prior to the settling of the claims of the various contestants, the Field interest and Edison interests decided to pool their issues and both assign their claims to any patent which might be granted on the invention to a concern in which both interests would be stockholders, and this was done in the formation of the complainant corporation on the assignment by the Edison interest (Mr. Edison and the Edison Electric Light Co.) of all their railway patents to the complainant, a controlling interest in the complainant was acquired by such Edison interest. It is claimed that after the granting of the patent in suit the minority (Field) directors could not get a quorum together for business purposes, as the majority (Edison) directors refused to attend such meetings; that the Edison interest then purchased a controlling interest in the Sprague Electric Railway & Motor Co., a competitor with complainant; that a suit at law was necessary to compel the attendance of the Edison directors; that the Edison directors refused to advance more money for the carrying on of complainant's business, though the Field directors offered to advance an equal amount; and that to save complainant corporation from going into a receiver's hands it was necessary for it to sell back to the Edison interests the patent rights originally received from them, in exchange for the stock of complainant corporation held by the Edison interests. It is further claimed, and admitted by counsel, that the real defendant in the case is the Edison General Electric Co., the successor to the Edison Electric Light Co., and that in view of its action, the Edison Company should be estopped from claiming as a defence, the *invalidity* of the patent in suit. Many cases were cited as bearing on this point.

The complainant claims infringement by the defendant upon the testimony of Mr. Franklin L. Pope, its expert, and Mr. S. D. Field, the patentee. In his testimony on this point, Mr. Pope says, among other things:

> "The length of this railway is not sufficient to render it necessary, and, perhaps, not advantageous to be operated in separate sections. As nearly as I could determine, it is, as a matter of fact, operated in one section only. I find in the defendant's plant as examined by me, all of the elements of the combination set forth in the first claim of complainant's patent in suit, or well-known equivalents therefor."

No testimony having been offered by the defendant of record, in denial of the witnesses above mentioned as to the construction and mode of operation of its plant and road, the infringement of its patent in suit must be considered as proven; some eight cases on this point are cited as references.

In considering the defenses set up by the Edison General Electric Co., the complainant presents them as follows: 1. The abandoned experiments of Thomas A. Edison. 2. The abandoned experiments of, and patent to, George F. Green. 3. Prior patents. 4. Prior publications. 5. Limited construction of the first claim of the patent in suit. 6. Insufficiency of invention.

These alleged defenses were then taken up in order and enlarged upon. The points brought out may be summarized as follows:

1. Mr. Edison had, in 1880 and in 1882, tried some extensive experiments at Menlo Park with electric railways. He had afterwards dismantled his experimental road by stowing away the old

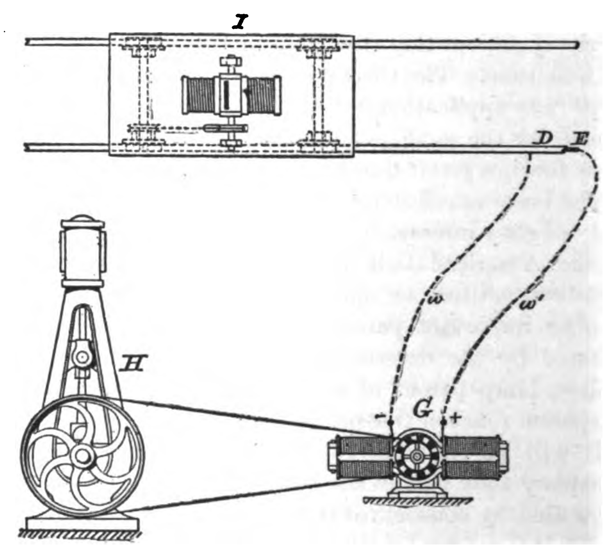


FIG. 5 OF FIELD'S PATENT, No. 408,188.

cars and motors, and taken up the rails. Immediately thereafter he joined issue with the Edison Electric Light Co. and the Field interest in the organization of complainant corporation. It is claimed therefore, that because Mr. Edison aided his associates in obtaining the Field patent he should be estopped from claiming anything, by virtue of his experiments; that the Edison General Electric Co. should be estopped on the same grounds; and that the experiments were abandoned.

2. On Sept. 15th, 1879, George F. Green, of Kalamazoo, Mich., filed an application for "a new and useful electric track and insulator" and on May 15th, 1886, filed an amended application seeking to embrace the elements of an electric railway. This latter application was brought into interference with the application of Mr. Field, the issue of that interference being the same as that in the first claim of the patent in suit. The Commissioner of Patents, in 1889, decided that Mr. Field, and not Mr. Green, was the inventor of the subject-matter therein. No suit having been brought on Mr. Green's behalf to retry the question of priority of invention, Mr. Green cannot now be heard to say that he was the prior inventor of the subject-matter of that interference. The Patent Office rejected the claims under Green's later specification, but on appeal to the Supreme Court of the District of Columbia they were allowed, and the patent No. 465,407 was issued on the allowance of the Court, and not of the Patent Office. The claims of the Green patent, however, in no way conflict with the first claim of the patent in suit. The applications of Mr. Green were based upon experiments made by him in 1856 and 1875. The testimony of Mr. Green shows that he used a voltaic battery as a generator and that after making the experiments he dropped them and gave his attention to other matters; in other words, they were abandoned.

3. What is claimed for Mr. Field's invention is that it was the first practical solution of the problem, in the combination of ele-

ments all of which were old in the art, but which were now for the first time assembled. Mr. Field's first reduction to practice was at Stockbridge, Mass., in 1881, in an experimental road about 200 feet long; and the second installation was in 1883 at the Exposition of Railway Appliances in Chicago, where an electric car called the "Judge" was run on tracks about the gallery of the building, carrying passengers from whom fare was collected. Mr. Field testifies that he conceived his invention in 1870 or 1871 and was only deterred from carrying it out through lack of funds and encouragement. Mr. Pope, complainant's expert, says that each of the devices and organizations of apparatus which defendant has referred to in the British patent of Pinkus, No. 8644 of 1840; British patent of Cooke, No. 514 of 1862; British patent of Dugmore and Milward, No. 2663 of 1863; U. S. patent of Wesson, No. 16,655; or British patent of Bielet and Derouvier, No. 2681 of 1864, are mere paper patents or descriptions, more or less vague, of impracticable apparatus. As to British patent of Clarke, No. 1386, of 1864, its apparatus is so crude as to be absolutely inoperative for the propulsion of a railway vehicle. In the motor there are eight "dead points" in each revolution in passing which the circuit is absolutely interrupted, which would quickly destroy the commutator and contacts in case a current sufficient for useful work was employed. In the practical car it would mean eight interruptions a second which would give a period too brief for the iron in the armature to receive sufficient magnetism. The defendant also quotes the French patent of Bové, No. 126,446 of 1878. Complainant claims this patent to have been improperly translated, "magneto-electric machine" having been translated "dynamo-electric" and the experts on both sides thereby misled in their testimony, and Mr. Pope especially, in making certain statements. Mr. Bové had in mind a Gramme magneto-machine and not a Gramme dynamo-electric machine. The former may be reversed by reversing the total current going to the motor; the latter cannot be reversed in that way. The Bové patent is defective in that it proposes the use of an earth return and in not describing a circuit controller which is the fifth element in the first claim of the patent in suit.

4. The publications which describe the installation of the Siemens Electric Railway of 1879, at the exposition in Berlin, are not anticipations of the invention covered by the first claim of the patent in suit, as none of those publications were issued before the filing of Mr. Field's caveat in the Patent Office. The other publications are claimed by complainant to be wholly unimportant.

5. Defendant claims that such a construction be put upon Claim 1 of the patent in suit as that the plant or defendant will escape infringement. The Field patent says the railway "may with advantage be operated in separate sections detached from each other, and with their terminal points in close proximity." This modification of the inventor's plan is only a *permissive modification* and not an imperative one. The patent further says that in case the railway "is of considerable length it may with advantage be operated in separate sections detached from each other and with their terminal points in close proximity." The railway of defendant being but about five miles long, does not need more than one section. Any length of road which can be operated from a central station, no matter how long it is, comes within the meaning of the first claim of the patent in suit.

6. Complainant claims that Mr. Field did make an invention in combining elements which, although individually old in the art, were brought by him together in an aggregation for the first time, constituting what was not only of value when he made it, but has proved of immense value as utilized by others since that time. Seven cases in support of this contention were cited by complainant. The complainant submits therefore that it is entitled to an injunction against the defendant of record, and to an accounting.

Defendant's Contention.

The defendant in answer states that the complainant is a corporation having a large nominal capital, but no money and no property but patents; that it possessed no factories or facilities for constructing and operating electric railways; that it has never constructed an electric railway experimentally, and has not even done any experimenting since 1887; and what it may have done before does not appear on the record. A glance at the prior state of the art shows that it was well advanced before 1879 and 1880, and that at that time means for accomplishing electric propulsion had been fully described and explained; that Field was by no means a pioneer inventor or the discoverer of any new art or principle, nor was there anything essentially new in any of his details of construction; he was at most only one of a series of improvers, each attempting to contribute something to the gradual progress of the art. Field did nothing, in practice, in the way of actual construction of electric railroads, using stationary sources of electricity, which had not been done in actual practice before.

The defendant's contentions with reference to anticipations of the Field patent by prior patents and publications are :—1. That, if the claim is given any construction under which it includes the defendant's apparatus, it is completely anticipated by the prior art; and 2. That, with any construction of the claim which avoids the prior art, and is consistent with its own language and that of the specification, the defendant does not infringe the claim.

The Siemens Publications. A German paper containing a detailed description of an electric railway constructed by Dr. Siemens in Berlin and operated beginning May 28, 1879, came to this country and a copy of it was received by the Patent Office on Oct. 9, 1879. The track was nearly one thousand feet long and the speed of the train was such that it traversed the distance in about one and one-half minutes. The train consisted of a locomotive and three cars, capable of carrying eighteen passengers and a fare of five cents was charged. It is believed by defendant, that with the construction contended for by complainant, the novelty of the first claim of the patent is negatived by the description given in this German publication. The article describes a Siemens dynamo, a Siemens motor, a circuit controller on the car, a wheeled vehicle, and a circuit of conductors, composed in part of the line of rails of a railroad track. This is admitted by complainant's expert, Mr. Pope, who says the description "discloses the same system or combination as is set forth in the first claim of the patent in suit." The publication by Siemens is prior to Field's application for a patent though subsequent to the date of the caveat, and defendant denies the proof of Field's caveat having contained the necessary data upon which could be awarded priority. The caveat is a secret paper, and the declarations of the caveat itself furnish at least a prima facie indication that the invention was not complete at its date, and complainant does not controvert this indication. Although Field says he *conceived* his invention in 1870 or 1871 he does not say *what* he conceived, or whether he had anything more than the idea that railways *might* be operated by electricity. It does appear in the record, however, that Field does not remember asking his partner, Mr. Ladd, who was furnishing money for his business, for money with which to procure a patent on his railway invention. That Field's caveat was not for a complete invention is shown by the fact that it does not specify the kind of dynamo electric machine which is to be used as a generator or motor, and yet the complainant contends this is an essential feature of the invention covered by the patent; that the patent relates to a system in which a conductor other than the rails is used as one side of the circuit, with an extra current collector, whereas the caveat covers a system of which the rails alone are used as conductors; that the system of the caveat is different from any that was practiced by Field, either at Stockbridge, Mass., or at Chicago. Moreover, the caveat does not differ at all from the prior art.

The defendant's case does not, however, rest solely upon the anticipations by Siemens, as the French patents of Bové, No. 126,446 dated Sept. 17, 1878, and Cretien, No. 128,075, dated Dec. 18, 1878, each in itself contains a complete anticipation of the first claim of the patent in suit. Complainant speaks of a mistranslation of "magneto" for "dynamo." This is the case, but only once out of fifteen times where "magneto" was used was it translated "dynamo." At any rate this is immaterial as at that time French writers referred to all classes of mechanical generators as "magneto-electric machines." The criticism made by complainant's expert on this patent in view of the fact that the ground is used between the rails and the generator as a return, is not a valid one, as Mr. Sprague for defendant, says that "the earth has been used as a direct medium for the transmission of current from the rails to the station and for a considerable distance," and two roads are mentioned where this is being practiced in this country to-day. The defendant states that complainant's objection to the Bové patent on the ground that no circuit-controller is mentioned is almost puerile in view of the fact that Bové says: "To stop the carriage it is necessary to break the circuit; to cause it to go backwards, the direction of the current is to be changed; and that to go forward again, the current is to be re-established in the original direction." Where else could the controller be placed than on the car to produce the desired result is not readily seen.

The defendant claims that the patent in suit is defective in many essential respects, due to lack of details which are necessary for its correct interpretation.

The complainant's position about the earlier patents is that their motors and generators are not such as are described in the claim in controversy. The defendant, however, contends that the patent in suit does cover such generators and motors as are disclosed in the early patents, and that these therefore negative any novelty in the patent in suit as well as do the later ones. Or, if this is not the case, the earlier generators and motors are so analogous to those of the Field patent that the substitution made by Field was an obvious one, and these patents negative any *invention* on the part of Field.

The British patent of Clarke, No. 1886 of 1864, is one which the Patent Office decided to contain the entire combination of Field's first claim, except the circuit controller on the vehicle; and under this claim Field canceled and abandoned such of his claims as did not contain this element. While defendant does not accept the opinion of the Patent Office that no circuit controller appears in the Clarke patent, it would seem immaterial, as com-

plainant's expert admits that there would be no invention in the addition of a circuit controller to the other elements. As to the experiments of George F. Green: Mr. Green was a mechanic of humble circumstances who built, in 1856, a small electric railway to demonstrate for his own satisfaction the correctness of his ideas on electric traction. In 1875 a much more extensive road was built near his workshop. Both roads were equipped with stationary voltaic batteries as the source of power, as Green was too poor to purchase a dynamo machine, although he realized the desirability of having one. The evidence shows that Green was: First to conceive and to disclose to others the combination of the first claim; first to embody such a combination or the equivalent thereof in actual working apparatus; and first to make application for a patent therefor. All of these steps were accomplished by Green before Field even made application for a patent, and Green's conception and reduction to practice were made before Field even filed his caveat.

Assuming that the first claim of the patent in suit does contain an invention, the defendant seems to have established that as between Edison and Field, Edison was the first to conceive of this invention and to disclose it to others in a complete form; and as between Edison and Field, Edison was the first to reduce the invention to actual practice. From testimony introduced, it appears that Edison conceived the idea as a complete entity in 1878 when he was returning from the West where he had been to observe an eclipse of the sun. Complete working drawings for his invention were finished and signed on May 18, 1879, three days before the filing of Field's caveat covering an incomplete agglomeration. Edison's reduction to practice in the building of his Menlo Park road in the spring of 1880 antedates Field's practical work by over twelve months.

The true meaning of the claim, is, to the defendant, very different from that set forth by the complainant. The "insulated and detached section of the line of rails" of the claim is held by defendant to mean simply an *automatic block system*, in which, according to the specification, the track is divided into sections corresponding to the distance between trains or cars, with a generator to each section only large enough for the propulsion of one train or car. The specification further says: "In case one car is following another *upon the same line of track* and should attempt to enter the *same section*, the current from the generator will be divided between the two cars, and the speed of each will be greatly reduced thereby." In view of the prior state of the art, it seems that if the claim covers any new and patentable invention, it must be confined to the novel block system.

Defendant's counsel, in closing, spoke of the relations between the complainant corporation and Edison General Electric Co., and argued against estoppel as claimed by complainant. He showed that the reason of the consolidation of the Edison and Field interests into the complainant corporation was due to the belief that an important invention was in controversy in the Patent Office between Edison and Field. This controversy was *not* over the first claim of the patent in suit, but involved two claims of a much broader and controlling nature. It was *these* claims (now cancelled) and *not* any *now existing* claim of the patent in suit, which the Edison interest believed to be valuable ones, and to secure which it entered into the arrangement with Field. It was not until April 1, 1889, three months before the patent was issued, that these two claims were canceled, and the invention became limited to the restricted claim which was finally allowed. Having already advanced large sums of money to the complainant corporation and being asked for more, the Field patent as issued was submitted to the highest patent authority in the land for a report as to its usefulness and merits. The report being decidedly adverse, the Edison interest negotiated with the Field interest and on the return of the Edison patents originally assigned to complainant the stock in complainant held by the Edison interest was assigned to the Field interest. And that the defendant, being a customer of the Sprague Electric Railway and Motor Company, subsequenty acquired by the Edison General Electric Company, the latter felt under obligation to conduct the defense of the suit brought against such customer.

MISCELLANEOUS.

STUDIES OF THE PHENOMENA OF SIMULTANEOUS CONTRAST-COLOR; AND A PHOTOMETER FOR MEASURING THE INTENSITIES OF LIGHTS OF DIFFERENT COLORS.—IV.

BY PROF. ALFRED M. MAYER.

A Photometer for measuring the intensities of differently colored lights.—It has already been shown that, in certain conditions of illumination and in certain directions of sight, a screen formed of perforated card-board covered with translucent paper appears with complementary colors, and that if the screen be in the form of a disc with alternate sectors cut out of it, and is illuminated on one side by daylight and on the other side by lamplight, that the blue of one side of the disc and the orange of the other appear intensified on slowly rotating the disc. On increasing the velocity of rotation the complementary colors gradually blend and when the velocity of rotation has banished all flickering light from the disc it appears nearly white. The side facing the daylight has a slight yellowish tint; the side facing the lamp appears whiter, but is tinted with a feeble bluish hue.

To study more minutely these phenomena I made a disc which could be readily taken apart and mounted with different translucent papers and have attached to it discs and rings of various colors. I shall call this disc, *the photometer disc*. It is made as follows:

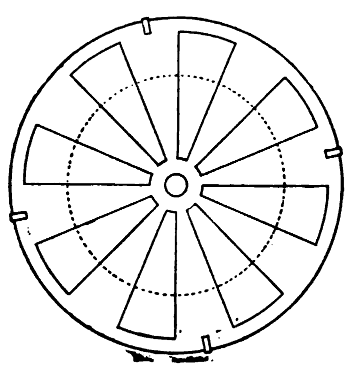


FIG. 13.

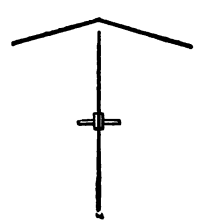


FIG. 14.

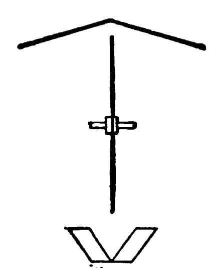


FIG. 15.

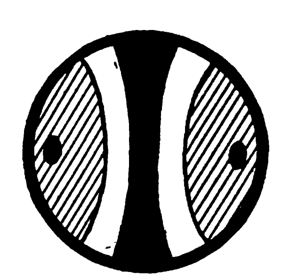


FIG. 16.

Two discs, 13 cms. in diameter, and having eight sectors cut out, as shown in Fig. 13, were made of thin Bristol board. A circle of 2 cms. in diameter was left in the centre of the disc, from which the card-board sectors radiate. The border of the disc is a ring of $\frac{1}{2}$ cm. wide, which was painted black. Clamps, made of thin hammered brass, held these discs together.

Between these discs was placed a circle of the same white translucent paper used in the construction of the large contrast-color screen, Fig. 1, and the discs were clamped together with the open sectors of the two discs coinciding in position. A black disc of 8.2 cms. in diameter was placed on each side of the photometer disc, thus leaving between it and the black peripheral ring an annular space 1.9 cm. wide, formed of alternate spaces of card-board and of translucent paper. The disc was mounted on a rotator and placed opposite two silvered mirrors inclined at an angle of 150°; an arrangement similar to that of Letheby for observing the disc of Bunsen's photometer. The plane of the disc of the rotator bisected the angle formed by the mirrors, as shown in Fig. 14, so that the surfaces of both sides of the disc could be seen simultaneously, or, rather, in rapid succession. On rotating the disc while illuminated by daylight on one side and by lamplight on the other, the side illuminated by daylight appeared white tinted with yellow; the side facing the lamp appeared white tinted with blue. The hues were the same as described in the experiment with the large disc, Fig. 8, only the surfaces appeared brighter by contrast with the black centre and border.

The feeble character of the hues on the photometer disc led me to hope that I could bring these to the same hue on both sides of the disc by the effects of contrast To accomplish this I placed on the daylight side of the photometer disc a compound disc formed of three split discs, one of red lead, one of chrome yellow, the other of white Bristol board. On the lamplight side I placed

a disc formed of three split discs, colored ultramarine, emerald green, and one of white Bristol board. On rotation, the compound disc on the daylight side gave an orange yellow; on the lamplight side the disc gave a bluish green. These colors corresponded in hue to those seen on the respective sides of the ring of the photometer disc when it is rotated, only the hues were much more saturated. After a few trials I brought, by the contrast effects of these colored discs, the tints on the two sides of the ring of the photometer to the same hue; the translucent ring appearing white with a very slight orange yellow tint on both of its sides. The greenish blue had by contrast effect obliterated the blue tint of the ring and even replaced it by a very feeble orange yellow; while on the other side of the ring the orange yellow disc had diminished the orange yellow tint of the ring to the same feeble orange yellow as seen on the other side of the ring.

Experiments were now made to test this apparatus as a photometer. Equality of illumination cannot be determined with any precision if the two surfaces compared differ even slightly in hue. Here we had the same hue to deal with on both sides of the ring; which condition is different from the Bunsen photometer on which we have two colors on each side of the disc. Various methods were tried to render reliable the comparison of the illumination of the two sides.

1.) I used the eye alone, regarding only the portions of the ring on the border near the mirror, as shown in Fig. 14.

2.) Two prisms reflected the images of portions of the sides of the ring nearest the mirror to juxtaposition, as shown in Fig. 15.

3.) A tube, blackened on the inside, with a black screen on the end next the disc, as shown in Fig. 16, was used. The eye was thus shielded from extraneous light and the comparisons of illuminations were made, as in experiments 1 and 2, on the portions of the rings which were nearest the mirror, as shown in Fig. 16. Vision through this screened tube gave the best results.

After practice in such comparisons, made during several hours on different days, I became more and more skillful and the results of measurements became more concordant; but such methods of photometry do not approach the accuracy of those in which two contiguous surfaces of different degrees of translucency coalesce into one surface of a uniform illumination, as happens on the balance of illuminations on the two sides of a Bunsen photometer disc when these are illuminated by lights of the same intensity and of exactly the same hue. A photometer for this mode of observation is described in the following section. It has, however, the advantage over the Bunsen photometer in that it serves to measure the intensities of differently colored lights.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 7, 1893.

Accumulators:—

Polarity Switch for Secondary Battery System, A. H. Whiting, New York, N. Y., 508,069. Filed June 1, 1893.

Consists of a polarized bar pivoted in a suitable support and having contacts or circuit closers at each end, each having co-operating stationary contacts,and an exciting coil for the bar connected across the main line terminals.

Alarms and Signals:—

Electric Time Signaling System, J. H. Gerry, Brooklyn, N. Y., 508,215. Filed Aug. 10, 1892.

Railroad Signal System, G. L. Thomas, Brooklyn, N. Y., and E. C. Seward, Montclair, N. J., 508,356. Filed July 1, 1893

A signal under the control of a passing frame to indicate to another train going in either direction its location with respect to certain predetermined sub-divisions of the track.

Conductors, Conduits and Insulators:—

Electric Cable, H. W. Fisher, Pittsburgh, Pa., 508,295. Filed Aug. 7, 1893.

Claim 1 follows:

In combination with the insulated wires an electric cable, one or more conductors having a high insulation, whereby they are protected as against an injury destructive of the insulation of the other wires of the cable.

Covering Electric Conductors, W. A. Conner, Pittsburgh, Pa., 508,370. Filed Dec. 6, 1890.

The invention relates especially to means for heating the wire while the covering is being applied.

Design for Insulator, A. Wright, Providence, R. I. Design 22,876. Filed Oct 3, 1893.

Dynamos and Motors:—

Electric Motor Apparatus, J. C. Davidson, Prince's Bay, N. Y., 508,000. Filed May 2, 1893.

Employs a primary series motor, a generator mechanically connected therewith, switch mechanism for starting the motor and electrical connections actuated by the lever of the switch mechanism after the motor is started to charge the field of the generator by part of the current passing through the motor armature.

Electric Motor, W. P. Carstarphen, Jr., Denver, Colo., 508,129. Filed Nov. 18, 1892.

Claim 2 follows:

In an electric motor the combination of an armature composed of an elongated H-shaped integral iron core wound from end to end and a movable commutator attached to one end of the armature to which the terminals of the armature coils lead, the field magnets, and a closed cylindrical iron shell or case surrounding the same, and a divided contact plate with which the terminals of the field coils are connected, and the movable cap carrying brushes engaging the armature and the divided contact plate.

Alternate Current Electric Motor, W. Stanley, Jr., Great Barrington, Mass., 508,188. Filed Oct. 23, 1888.

Employs armature and field magnet coils separately wound and separately connected, and a supplemental coil surrounding the armature and connected in circuit therewith.

Regulator for Dynamo Electric Machines, A. M. Cullingworth, New York, 508,208. Filed May 6, 1892.

Employs a magnetic body pivotted upon the metal of the machine in the magnetic circuit and adapted to vibrate in proximity to the armature for the purpose of operating the current regulator.

Electric Tool, G. H. Williams, New York, 508,262. Filed Dec. 28, 1892.

An electric reciprocating tool adapted especially to engraving, sculpture, etc.

Galvanic and Thermo Electric Batteries:—

Carbon for Voltaic Cells, E. B. Cutten, New York, N. Y., 508,091. Filed March 28, 1893.

Claim: The combination of a carbon electrode for a voltaic cell, and a carbon holder or terminal therefor, one of said parts being impregnated with paraffine and inserted in a recess formed in the other part, and an external envelope of insulating material, such as paraffine, surrounding the said parts at the joint.

Heating:—

Electrically Heated Soldering Iron, C. L. Coffin, Detroit, Mich., 500,284. Filed Dec. 10, 1892.

Lamps and Appurtenances:—

Incandescent Electric Lamp, C. R. Arnold, Sharon Hill, Pa., 507,978. Filed Feb. 28, 1891.

Employs a hollow glass stopper having the leading-in wires sealed between the stopper and the neck; a reflector at the end of the stopper next to the filament, and a filling of plaster of paris.

Carbon Holder, C. C. Hill, Newport, R. I., 508,314. Filed Jan. 18, 1893.

Consists of a cylindrical longitudinally slotted socket provided with thickened ends and furnished with a circumferential groove near one end and a circular spring fitted into the groove.

Extension Electrolier, A. Rivenburgh, Greenfield, Iowa, 508,343. Filed July 27, 1893.

Electric Arc Lamp, B. Adair & C. H. Klewer, Denver, Colo., 508,392. Filed March 6, 1893.

A cut-out for a Brush arc lamp consisting of a magnet with its coils in the shunt circuit, a short circuit connection through the armature of the magnet when the latter is sufficiently energized, another magnet whose coils are in the main lamp circuit and a short connection through the armature of this magnet when not energized.

Miscellaneous:—

Clamp for Holding Articles While Being Welded, A. J. Moxham, Johnstown, Pa., 508,037. Filed Feb. 2, 1893.

Circuit Breaking Device for Reciprocating Electric Machines, C. H. Richardson, Philadelphia, Pa., 508,050. Filed July 2, 1892.

Consists of a rigid and movable contact piece carried by the reciprocating member and operating to break the circuit at the end of the attractive stroke and make it on the completion of the release stroke by the momentum of the movable contact.

Lightning Conductor, G. T. Walch, Kaufbeuren, Germany, 508,068. Filed Feb. 21, 1893.

Diaphragm Used in Electrolytic Processes, A. Breuer, Iserlohn, Germany, 508,084. Filed Sept. 14, 1892.

Composed of a cement adapted to harden when combined with water, and of an organic body soluble in liquid.

Insulating Compound for Printing Presses, H. Haynes, Philadelphia, Pa., 508,107. Filed April 29, 1893.

Claim:

An insulating compound for a printing press composed of machine oil, wax, glycerine and castor oil.

Electrolytic Apparatus, J. C. Richardson, London, Eng., 508,241. Filed March 26, 1891.

Has for its object to facilitate the electrical decomposition of chloride of sodium for the production of chlorine and caustic soda.

Electric Rotary Flue Cleaner, F. Gardner, Chicago, Ill., 508,360. Filed Feb. 23, 1893.

Railways and Appliances:—

Electric Locomotive, J. I. Conklin, Brooklyn, N. Y., 508,997. Filed Dec. 8, 1892.

Employs mechanism for driving the car from the wheels themselves instead of the axle.

Electric Railway System, O. T. B. Brain, Liverpool, Eng., 508,093. Filed Aug. 29, 1891.

Employs a slotted conduit with a continuous cover consisting of hard rails forming a bridge over the slot capable of supporting the road traffic and made of a material capable of flexure, the rails being connected together and adapted to be raised from the slot as the car passes and to reseat themselves behind the car.

Conduit Railway Trolley, H. A. Goreham, Decatur, Ill., 508,104. Filed Jan. 31, 1893.

Relates particularly to a spring device for holding the trolley against the wire in the conduit.

Closed Conduit Electric Railway, O. B. Henton, Cleveland, O., 508,199. Filed May 31, 1893.

Employs a movable contact maker and insulated means before and behind the current conveyer connected to the car adapted to press the contact maker against the conductor.

Conduit Electric Railway, J. Pawolowski, Cincinnati, O., 508,236. Filed Feb. 27, 1893.

Has for its object to divide the road into blocks each one of which is entirely independent of the others.

Electric Regulator and Switch, W. N. Jones, Jr , Petersburg, Va., 508,322. Filed July 20, 1893.

A regulator in which the same adjusting devices serve to regulate the current to both the motor and the brake magnets without allowing the current to be on the motor and the brake magnets at the same time.

Electric Railway, R. M. Hunter, Philadelphia, Pa., 508,388. Filed Nov. 30, 1886.

Employs outgoing and return conductors, a constant potential and varying current dynamo, two or more electrically propelled cars connected with the conductors in parallel and each operated by a series wound electric motor.

Telegraphs:—

Telegraph Key, J. R. Frank, Minneapolis, Minn., 508,214. Filed May 29, 1893.

Telephones and Apparatus:—

Automatic Signal for Trunk Lines of Telephone Exchanges, O. A. Bell, Brooklyn, N. Y., 507,983. Filed Feb. 7, 1893.

Relates particularly to apparatus for the transmission of automatic disconnection signals over trunk lines of exchange systems employing but two conductors, one of which may be one of the trunk line wires.

Multiple Switchboard System for Telephone Exchanges, C. E. Scribner, Chicago, Ill., 508,054. Filed Feb. 7, 1893.

Relates especially to the signal receiving devices of the different lines at the exchange and means for preventing their operation during connection between the lines.

Telephone Circuit, J. S. Stone, Boston, Mass , 508,255. Filed Jan. 31, 1893.

Employs a common current generator for the transmitters of the system, a number of telephone circuits of approximately equal resistance in parallel with the generator, and a relatively high inductance device connected in series with the common generator.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 14, 1893.

Alarms and Signals :—

Electrical Contact Making Device, W. F. Z. Desant, New York, 508,871. Filed Dec. 14, 1892.

A contact device for railroads to operate electric signals, etc.

Conductors, Conduits and Insulators :—

Wire Connector, G. A. Trumbull, Bellevue, Ky., 508,587. Filed July 18, 1893.

Consists of a shell containing a pair of compressible sleeves holding the wire against tension.

Underground Electric Conductor, J. C. Henry, Westfield, N. J., 508,613. Aug. 8, 1892.

Consists of pipe sections having insulating supports at intervals within them and means for automatically taking up slack in the conductors.

Insulating Composition, E. Thomson, Swampscott, Mass., 508,653. Filed Nov. 2, 1891.

Consists in applying non-carbonaceous material to sheets of paper, piling the sheets together and drying the entire mass.

Cleat for Electric Wiring, F. A. Duggan, Trenton, N. J., 508,687. Filed June 28, 1893.

Claim : An improved cleat for wiring purposes having its two parts interchangeably alike with corrugated notches on their inner faces.

Distribution :—

Current Transformer, W. H. Hornberger, Elkhart, Ind., 508,422. Filed Dec. 17, 1892.

Means for Regulating Multiphase Currents, E. W. Rice, Jr., Lynn, Mass., 508,638. Filed Jan. 19, 1893.

Employs adjustable current-varying devices in the separate circuits and means for operating all of such devices simultaneously.

System of Electrical Distribution, E. Thomson, Swampscott, Mass., 508,646. Filed Dec. 19, 1890.

Provides means for supplying an extended area with electric currents of different voltages

Electric Lighting System, E. Thomson, Swampscott, Mass., 508,617. Filed Aug. 12, 1891.

A system adapted especially to small light-houses, electric buoys, etc.

Electrical Transformer, E. Thomson, Swampscott, Mass., 508,650. Filed Aug. 28, 1891.

The invention relates especially to retaining the insulation of the primary coils and carrying away the heat from them.

Cooling Transformer, E. Thomson, Swampscott, Mass., 508,654. Filed Feb. 4, 1892.

A chamber containing one or more transformers surrounded by an insulating fluid with a cooling medium circulating in a pipe through a portion of the fluid.

Electric Transformer, E. Thomson, Swampscott, Mass., 508,655. Filed Feb. 4, 1892.

Relates to certain improvements for boxing in the transformer and holding it in place.

Electrical Transformer, A. Ekstrom, Lynn, Mass., 508,688. Filed Nov. 16, 1892.

Employs a plurality of primary and secondary coils the former connected in series and the latter in multiple with a single work circuit.

Electric Distribution, E. W. Rice, Jr., Swampscott, Mass., 508,838. Filed May 13, 1893.

Employs a motor generator actuated by alternating current and delivering continuous current to a circuit and a continuous current generator in such circuit adapted to raise the electromotive force of the current therein.

System of Electrical Distribution, E. W. Rice, Jr., Swampscott, Mass., 508,839. Filed May 31, 1893.

Claim 1 follows :

A multiphase transformer supplying separate translating devices from each coil of its secondaries.

System of Electric Distribution, W. S. Moody, Lynn, Mass., 508,893. Filed March 17, 1893.

Employs a transformer having its low potential coils wound on the "mesh" system, and its high potential coils wound on the "star" system.

Dynamos and Motors :—

Device for Indicating Synchronism, C. F. Scott, Pittsburgh, Pa., 508,489. Filed Sept. 28, 1892.

Method of Regulating Self Exciting Alternate Current Electric Generators, W. Stanley, Jr., Great Barrington, Mass., 508,493. Filed Oct. 18, 1893.

The method consists of exciting the field magnet of the generator by a current derived solely from a circuit in shunt with the work circuit and causing the work circuit to act inductively upon the shunt circuit to vary its counter-E. M. F. in inverse ratio to the quantity of current in the work circuit.

Field Magnet Coil and Method of Manufacturing Same, J. Johnson and C. D. Haskins, Lynn, Mass., 508,620. Filed May 2, 1893.

The method consists in forming a ring provided with terminals and then breaking the continuity of the ring by a cut.

Brush Holder for Dynamo Electric Machines, E. R. Knowles, Middletown, Conn., 508,624. Filed March 20, 1893.

Comprises a follower sliding parallel with the brush and rotatable about its axis of motion.

Fluid Pressure Device for Controlling Electric Motors, H. F. Parshall, Lynn, Mass., and J. W. Darley, Jr., Baltimore, Md., 508,630. Filed May 6, 1893.

Employs a cylinder carrying electric contacts and adapted by its rotation to vary the speed of the motor, and means operated by fluid pressure to rotate the cylinder.

Mounting Armatures for Dynamo-Electric Machines, E. D. Priest, Lynn, Mass., 508,634. Filed May 15, 1893.

Consists of two sleeves, one keyed to the shaft and the other secured to the armature ; a space between the two sleeves one of which is provided with pockets and an elastic medium filling the space and the pockets.

Connector for Dynamo-Electric Machines, H. G. Reist and J. P. B. Fiske, Lynn, Mass., 508,636. Filed July 3, 1891.

Has for its object to provide simple means for adjusting the length of the field magnet winding.

Armature Core, H. G. Reist, Lynn, Mass., 508,637. Filed May 24, 1893.

A laminated core built up in sections and having separators attached to the laminæ between two consecutive sections.

Protection for the Insulation of Dynamo-Electric Machines, E. Thomson, Swampscott, Mass., 508,649. Filed Aug. 26, 1891.

Provides means for protection against lightning or induced static discharges.

Contact Apparatus, E. Thomson, Swampscott, Mass., 508,651. Filed Sept. 17, 1891.

Relates chiefly to commutators and methods of insulating their parts one from another.

Dynamo-Electric Machine or Motor, E. Thomson, Swampscott, Mass., 508,658. Filed May 23, 1892.

A motor having each helix composed of a series of coils of successively finer wire and means for switching one or more of the coils into circuit while the motor is running.

Alternating Current Motor, J. F. Kelly and C. C. Chesney, Pittsfield, Mass., 508,721. Filed Jan. 16, 1893.

Employs two commutating motors mechanically coupled together and so connected with the line circuits that the armature of each will be supplied with current from the same circuit as the field of the other.

Fan Motor, W. S. Hill, Hyde Park, Mass., 508,710. Filed June 7, 1893.

A motor pivotally mounted and provided with means for rotating, operated by the air pressure received from the fan.

Electric Generator, W. S. Hill, Hyde Park, Mass., 508,880. Filed April 12, 1893.

A very small generator operated by hand for medical use, etc.

Galvanic and Thermo-Electric Batteries :—

Battery Element, W. Mills, Elizabeth, N. J., 508,551. Filed Oct. 18, 1892.

Has for its object the support of the carbon element from the top of the cell and its insulation from the cell and the other elements.

Battery Element, W. Mills, Elizabeth, N. J., 508,897. Filed Nov. 11, 1892.

The method consists in combining granules of stone and a carbonaceous material into a non-porous mass, granulating the mass and re-conforming the granules into a porous mass.

Lamps and Appurtenances :—

Electric Lamp for Bicycles, G. Mayr, Brooklyn, N. Y., 508,482. Filed March 27, 1893.

Electric Lighting System, T. A. Willard, Norwalk, Ohio, 508,559. Filed Aug. 29, 1893.

Relates to automatic regulators for incandescent light circuits taking current from accumulators.

Electric Car Lighting System, J. C. Henry, Westfield, N. J., 508,616. Filed April 3, 1893.

Employs a motor and a clock running in opposite direction, an adjustable resistance and lamps controlled thereby, and gearing operated by the motor and the clock increasing or diminishing the resistance inversely as the current driving the motor varies.

Stand for Testing Electric Arc Lamps, E. R. Knowles, Middletown, Conn., 508,623. Filed Nov. 29, 1892.

Stand for Controlling Electric Circuits, E. R. Knowles, Middletown, Conn., 508,626. Filed May 10, 1893.

Designed especially for the control of distant search lights.

Search Light, A. L. Rohrer, Lynn, Mass., 508,642. Filed June 20, 1893.

Provides means for the mechanical manipulation of a search light from a short distance away.

Electric Arc Lamp, E. Thomson, Swampscott, Mass., 508,656. Filed Feb. 4, 1892.

Claim 1 follows :

The combination with the rotary support for the carbon holder having a depression, of a circuit controller engaging with such support and means for impelling the engaging parts of such controller into said depression.

Leading-in Wire for Incandescent Lamps, E. Thomson, Swampscott, Mass., 508,659. Filed May 23, 1892.

Employs separate supports for the filament sealed into the stem of the lamp and serving to connect the leading-in wire with the filament.

Apparatus for treating Filaments for Incandescent Electric Lamps, H. D. Burnett, Lynn, Mass., and S. E. Doane, Swampscott, Mass., 508,678. Filed Aug. 23, 1893.

Measurement :—

Detector for Electric Current Meters, E. Thomson, Swampscott, Mass., 508,660. Filed Nov. 25, 1892.

An electromagnetic device controlled by the main line circuit and adapted to operate when the meter is shunted.

Electric Meter, E. Thomson, Swampscott, Mass., 508,661. Filed May 12, 1893.

Employs series field coils, an armature induced thereby and a transformer having a primary in shunt to the mains and a secondary in the local circuit with the armature.

Indicating Apparatus for Electric Circuits, E. Thomson, Swampscott, Mass., 508,662 Filed July 1, 1893.

Claim 2 follows :

An electric measuring instrument comprising a voltmeter mechanism having a movable scale and means actuated by the direct current adapted to move the scale.

Magnetic Permeameter, E. D. Knap, Schenectady, N. Y., and S. D. Sprong, East Greenwich, N. Y., 508,837. Filed June 28, 1893.

Miscellaneous :—

Electric Door Opener, H. T. Johnson, New York, N. Y., 508,518. Filed May 19, 1893.

Connector for Electromagnet Coils, M. O. Southworth, Lynn, Mass., 508,643. Filed Jan. 31, 1893.

A connector composed of a strip of metal doubled together and formed into an eye around a rigid bushing.

Reactive Coil, E. Thomson, Swampscott, Mass., 508,657. Filed Feb. 15, 1892.

Comprises two or more coils angularly adjustable to vary the intensity of the resulting magnetic field and a switch arranged to cut out the coils automatically when placed on the position of minimum reactive effect.

Rheostat, J. B. Blood, Lynn, Mass., 508,674. Filed Feb. 23, 1892.

Electric Elevator, A. T. Chase, Cambridge, Mass., 508,680. Filed Dec. 16, 1891.

Employs a switch for controlling the elevator and operated by the opening and closing of the elevator door.

Electric Elevator Controller, J. P. B. Fiske, Lynn, Mass., 508,691. Filed July 18, 1891.

A multiple contact switch operated automatically as the car approaches the top or bottom of the shaft.

Rheostat for Controlling Electrically Operated Dental Apparatus, J. P. B. Fiske, Lynn, Mass., 508,692. Filed July 10, 1893.

Process of and Apparatus for Dissociating of Alkalies by Electrolysis, H. S. Blackmore, Mt. Vernon, N. Y., 508,804. Filed Sept. 8, 1892.

Means for Cutting Ice, L. Daft, Seattle, Wash., 508,819. Filed May 2, 1893.

An electrical cutter for artificial ice machines.

Electrical Condenser, J. F. Kelly, Pittsfield, Mass., 508,887. Filed June 10, 1893.

Railways and Appliances :—

Electric Railway Trolley, J. Chase, Rochester, N. Y., 508,535. Filed April 8, 1893.

A divided trolley arm and self oiling wheel.

Electric Railway Trolley, S. D. Field, Stockbridge, Mass., 508,539. Filed March 2, 1891.

A magnetically adhesive trolley having a magnetized wheel provided with contact faces separated by a space laterally conforming to the cross section of a portion of the stationary conductor.

Conduit for Electric Railways, A. J. Robertson, New York, 508,578. Filed Jan. 6, 1891.

A conduit for a bare electric wire, having storage capacity for water and an inner surface of insulating material.

Electric Railway, J. C. Henry, Westfield, N. J., 508,615. Filed Sept. 10, 1892.

Employs a series of poles arranged alternately on opposite sides of the roadway, a working conductor and short guy wires running from each pole to the conductor.

Electric Railway Trolley, W. H. Knight, New York, 508,622. Filed Aug. 10, 1888.

An overrunning trolley connected with the car by a light but rigid pole.

Electric Railway Motor, E. D. Priest, Lynn, Mass., 508,633. Filed Feb. 23, 1893.

Claim 1 follows:

An electric motor having its pole pieces loose and separate from the remainder of its field magnet.

Trolley for Electric Railways, N. C. Bassett, Lynn, Mass., 508,669. Filed July 18, 1892.

A device for locking the trolley pole in a depressed condition.

Switch for Electric Railways, E. M. Bentley, New York, 508,672. Filed Aug. 31, 1889.

A switch consisting of a section of conductor having a free end normally in contact with the main conductor adapted to lead the trolley onto the switch in one direction but to yield, allowing the trolley to remain on the main line in the opposite direction.

Brake Apparatus for Electrically Propelled Cars, F. O. Blackwell, New York, 508,673. Filed Sept. 16, 1889.

A brake actuated by the power of the car, and a common controlling device for the brake and the motor.

Construction of Trolley Lines, G. Q. Seaman, Brooklyn, N. Y., 508,771. Filed July 22, 1893.

Provides means for cutting out a broken section of trolley wire without interfering with adjacent sections.

Electric Brake for Railways, A. De Bovet, Paris, France, 508,805. Filed April 23, 1892.

Consists of a series brake shoes mounted on flexible plates partly surrounding brake pulleys, and coils of insulating wire arranged in annular chambers in the brake pulleys.

Converter System for Electric Railways, C. S. Bradley, Yonkers, N. Y., 508,807. Filed May 31, 1887.

Has for its object to enable the ordinary rails of the track to supply the current by feeding the rails with a current of such low electromotive force as to obviate any danger from accidental short circuiting.

Electric Brake, R. B. Skinner, Ogden, Utah, 508 851. Filed Jan. 21, 1893.

Employs a solenoid for operating the brake-lever.

Switches and Cut-Outs:—

Switch Box for Controlling Electric Circuits, E. R. Knowles, Middletown, Conn., and E. H. Park, Millbury, Mass., 508,625. Filed March 31, 1893.

Relates to a signaling system especially designed for ships.

Safety Cut-Out, O. Offrell, Middletown, Conn, 501,629. Filed Dec. 5, 1892.

A ceiling cut-out having the fuses mounted on the inner face of a flat cover that they may be easily applied and renewed.

Electric Arc Disrupter, W. B. Potter, Lynn, Mass., 508,632, Filed July 13, 1893.

Claim 1 follows:

The combination with terminals at which an arc may be formed of a blow-out magnet provided with a closed conductor surrounding its core.

Switchboard for Power Stations, A. L. Rohrer, Lynn, Mass., and G. W. Mansfield, Melrose, Mass., 508,641. Filed March 5, 1891.

Employs automatic circuit breakers and their connections, two or more generators connected in multiple and a resetting device engaging with switching devices in each of the circuits to close the latter simultaneously.

Branch Block for Incandescent Lighting Circuits, A. Swan, Schenectady, N. Y., 508,644. Filed May 23, 1892.

Lightning Arrester, E. Thomson, Swampscott, Mass., 508,648. Filed Aug. 26, 1891.

Electric Cut-Out, E. Thomson, Swampscott, Mass., 508,652. Filed Sept. 17, 1891.

An arc rupturing device employing a non-conducting liquid and means for immersing one terminal in the liquid.

Fuse Plug, H. C. Wirt, Boston, Mass., 508,665. Filed May 26, 1893.

Telephones and Apparatus:—

Combined Messenger Call and Telephone, G. E. Christie, Paterson, N. J., 508,563. Filed Feb. 24, 1893.

The inventions consist in placing in the main circuit of a messenger call box a telephone with a switch by means of which the telephone may be alternately brought into and out of the main circuit.

Telephone Transmitter, E. Noriega, Mexico, 508,829. Filed Feb. 4, 1891.

Employs a carbon electrode formed of charcoal, coke and a solution of boric acid.

Electric Telephone, E. Noriega, Mexico, 508,830. Filed Aug 25, 1892.

Employs one or more carbon cylinders enclosed by iron ferrules separated from the carbon by insulating material.

Multiple Switchboard, M. G. Kellogg, Chicago, Ill. Reissued, 11,386. Filed Dec. 8, 1890.

Relates to a metallic circuit exchange system and an arrangement for testing at any board to determine whether a line is in use at another board.

Multiple Switchboard, M. G. Kellogg, Chicago, Ill. Reissued, 11,387. Filed Jan 8, 1891.

Similar to 11,386.

Multiple Switchboard, M. G. Kellogg, Chicago, Ill. Reissued, 11,388. Filed Jan. 23, 1891.

Similar to 11,386.

Society and Club Notes.

ELECTRIC LIGHT ASSOCIATION.—NEXT ANNUAL MEETING AT WASHINGTON, D. C.

A meeting of the Executive Committee of the National Electric Light Association was held at the Hotel Lafayette, Philadelphia, Friday afternoon, November 24, Judge Armstrong, President of the Association in the chair. The following members of the Committee were present: Messrs. A. J. De Camp, J. A. Seely, E. F. Peck, H. H. Fairbanks, H. J. Smith and C. O. Baker, Jr., and Mr. Geo. F. Porter, Secretary of the Association. By the courteous invitation of Judge Armstrong there were also present Mr. C. W. Price, Mr. Geo. M. Phelps and Mr. Tullis, of the electrical press, Mr. J. J. Burleigh, of Camden, N. J., and Mr. R. B. Corey of New York. The chairman invited all the gentlemen present to take part in the proceedings.

After the reading of letters by the secretary suggesting several places of meeting it was voted to hold the next annual convention at Washington, D. C., February 27–March 1, 1894.

A Committee of arrangements for the annual meeting was appointed, consisting of Messrs. C. O. Baker, Jr., F. W. Royce, S. M. Bryan and M. J. Francisco.

Messrs. A. J. De Camp, C. W. Price and H. H. Fairbanks were appointed a Committee on Programme for the Convention.

The subject of permanent quarters at New York was discussed and Messrs. J. A. Seely, E. F. Peck and C. O. Baker, Jr., were made a committee to consider and report with special reference to rooms in the new Postal Telegraph Building, where, it appeared, desirable facilities were offered.

Letters of regret were read from Vice-President Wilmerding, Ex-President Huntley and W. J. Morrison, none of whom was able to the present.

The meeting was followed by a very delightful dinner given by Judge Armstrong at the Union League Club—where good cheer and enjoyable communion prevailed till train time came for those who had journeys between themselves and home.

NEW YORK ELECTRICAL SOCIETY.

On Wednesday, the 29th inst., the New York Electrical Society will hold a symposium at Columbia College, 49th street and Madison avenue, at 8 p. m. The subject of the evening will be "Electricity at the World's Fair and its Lessons."

Brief addresses will be given by J. J. Carty, on Telephones; Prof. F. B. Crocker, on Electrical Congresses; Charles Cuttriss, on Cables; Dr. C. E. Emery, on Electric Light Engines; James Hamblet, on Electric Clocks; C. O. Mailloux, on Storage Batteries; T. C. Martin, on Electric Lighting; Nikola Tesla, on his new Electrical Oscillator; Jos. Wetzler, on Transportation; and Schuyler S. Wheeler, on Electric Motors.

A large number of lantern views of the World's Fair will be thrown on the screen. Ladies will be welcome at this meeting.

BANQUET OF THE ELECTRICAL ENGINEERS IN LONDON.

At the annual dinner in the Institute of Electrical Engineers on Nov. 22, Mr. Arnold Morley said that English success with the telegraph had placed England in the foremost place among nations, even if she was not entitled to claim to have surpassed America. Mr. A. J. Mundella mentioned the success with the Electrical Standards which the United States, France, and Germany were ready to adopt. He said he would soon submit an order in council adopting the electrical standards as the standards of Great Britain.

President Preece said that there was only one branch of the electrical industry in which the English favorably compared with their American cousins. They were, he said, certainly ahead in telegraphy; but behind in every other branch, especially in telephony.

Personal.

MR. B. J. ARNOLD.

After five years' service with the General Electric Company, and its allied interests, Mr. B. J. Arnold has resigned from the position of consulting engineer for the purpose of practicing independently, and has opened an office at 565 The Rookery, Chicago, as a consulting and constructing electrical engineer, making a specialty of elevated and surface electric railway construction, and the designing and installation of power stations. Mr. Arnold has had an extended experience in reporting upon the financial and physical condition of electrical properties for investors, and will make this and the appraising of insurance losses leading features of his business. Prior to entering the employ of the General Electric Company, he was engaged in the construction of steam railways, and for the past year has acted as consulting engineer for the Columbian Intramural Railway Co., at the World's Fair.

EXPORTING ELECTRICAL APPARATUS TO BRAZIL.

Mr. W. A. Vail, 136 Liberty street, general agent for the National Electric Manufacturing Co., has sold for export this week two 2,500 National alternating current lighters, 5,000 light capacity of National transformers for immediate shipment and a duplicate order for shipment in six weeks. These machines are going to the northern part of Brazil, and are being installed by one of the largest contractors in this country.

COMMERCIAL CABLE.

Before Mr. Hamilton Odell as referee, a suit is now in progress in this city, brought by Count Arthur Dillon, of Paris, to recover from the Commercial Cable Co., J. W. Mackay and James Gordon Bennett the sum of $500,000, which amount is said to represent 266 shares of preferred cable stock and interest, due for services rendered.

The Metropolitan Electric Company, 522–523 Monadnock Building, Chicago, are introducing the "Anti-Thunder-bolt" oil paper for armatures, etc.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE CHLORIDE ACCUMULATOR.

THE ELECTRIC STORAGE BATTERY Co., of Philadelphia, whose "Chloride Accumulator" was recently described in the ENGINEER

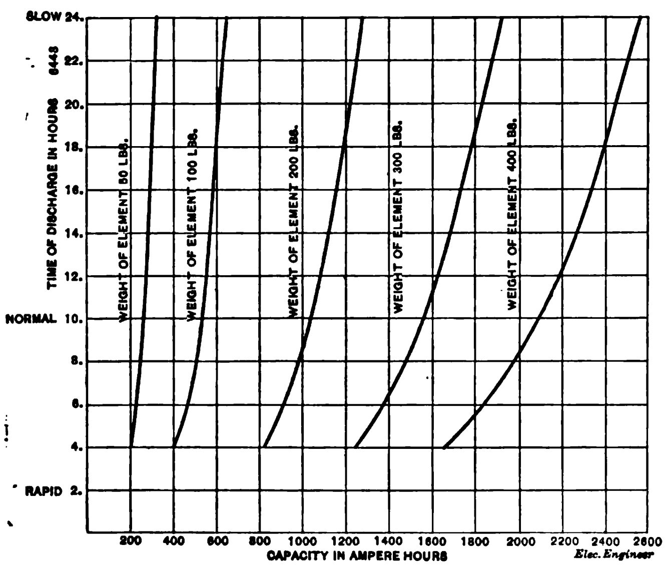


FIG. 1.

have just issued a neat illustrated pamphlet containing a brief account of the merits of their cells and giving additional information regarding some important points in storage battery operation.

Among the interesting points brought out are the curves showing the capacity of these cells at different rates of discharge. It is well known that storage cells diminish in capacity with increased rate of discharge and it is evident that where cells are called on for heavy rates of discharge this feature becomes one of considerable importance where economy of operation is desirable. The accompanying curve, Fig. 1, shows the capacity of the Chloride Accumulator under these varying conditions. This curve, it will be noted, embodies the results of tests, made on cells the elements of which vary from 50 to 400 pounds, the time of discharge varying from 4 to 24 hours. In every case there is shown to be a difference in capacity of only one third between the lowest and highest rate of discharge. Thus while the smallest element weighing 50 pounds has a capacity of 320 ampere hours when discharged in 24 hours, its capacity is still as high as 210 ampere hours when discharged in 4 hours, that is, at six times the previous

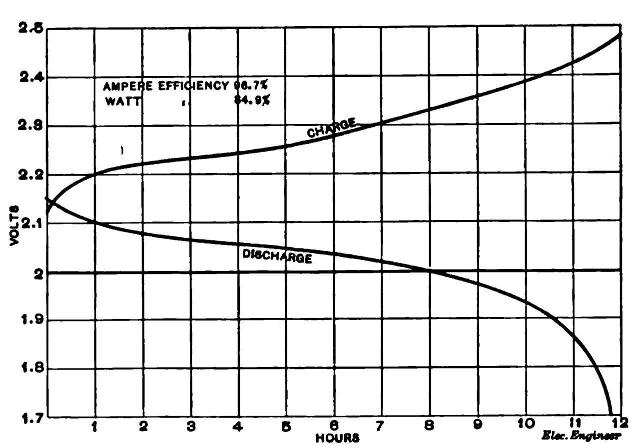


FIG. 2.

rate; and this capacity is even then only 20 per cent. below that of its normal.

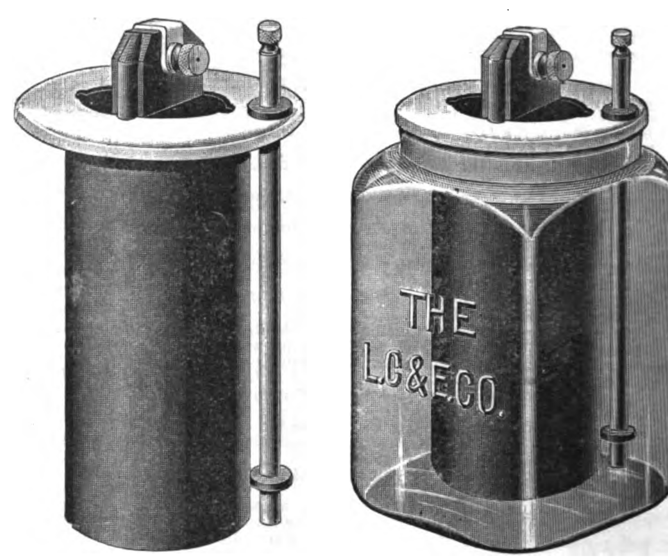
Another striking feature of the cells is shown in the curve, Fig. 2, which illustrates the E. M. F. during charge and discharge. Referring to the discharge curve it will be seen that the potential of the cell is maintained above 2 volts up to the point at which the cell has been discharged of two-thirds of its capacity. As the cases would be few in which a storage cell would be called on for more than two-thirds of its capacity before recharging occurred the value of having the potential maintained above 2 volts per cell is self evident.

An essential feature in an efficient accumulator and one upon which the regulation largely depends, is the internal resistance. This has also been specially considered with the result that the Chloride traction accumulator has an internal resistance of only .002 ohm, while the larger cells, of course, show a proportionately lower resistance. The catalogue also contains a valuable table giving the sizes, weights, capacities and prices of cells the elements of which vary from 18 to 1,000 pounds, together with some strong testimonials as to the high character of the Chloride Accumulator.

THE IMPROVED LACLEDE BATTERY.

THE accompanying illustrations show the improved Laclede battery just placed before the public by the Laclede Carbon and Electric Company, of which Mr. P. C. Burns is manager, formerly of Peru, but now located at Kokomo, Ind. The inventor, Mr. Burns, states that this is his latest and best effort and is far superior to the old style of cylinder battery. When it is considered that the inventor has had the most extended experience in the manufacture of open circuit batteries, the value of his opinion will not be doubted.

The makers claim that the jar used in connection with this battery, being of large size and made of good, strong glass, will stand shipment much better than the old style; that the carbon is of the best quality for battery purposes; that the zincs and sal ammoniac are the best that can be secured for the purpose; that the



IMPROVED LACLEDE BATTERY.

porcelain cover is an improvement over the old style as it holds the carbons and zinc in position, overcoming an objectionable feature of the old style Laclede battery, and will also fit any jar, and that the carbon connection is a great improvement over the old style. It is guaranteed not to corrode.

Mr. Burns is also the inventor of the Microphone battery as well as the old styles of Laclede and Hercules batteries.

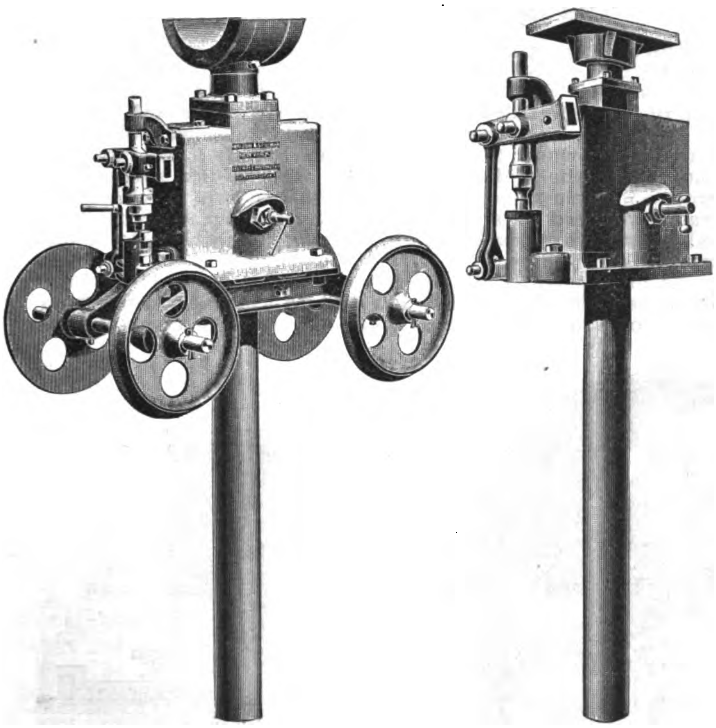
A CORRECTION.

WE regret that an error was made week before last in our description of the vertical cross compound Ball engine. Referring to the illustration the text should have read: "The view shows a cross compound vertical engine, the high pressure cylinder of which is 16", low pressure cylinder 28", stroke 16", revolutions, 240."

CUMNER, CRAIG & Co., electrical engineers and manufacturers' selling agents, write that on December 1st they will consolidate their office, stock rooms and workshop at 69 Broad street, Boston, Mass., and with their increased facilities will be able to show their friends the productions of the manufacturers for whom they are selling agents. Among these are the American Wire Glass Manufacturing Co., Bishop Gutta-Percha Co., Crocker-Wheeler Electric Co., Frisbie Elevator and Manufacturing Co., General Incandescent Arc Light Co., Interior Telephone Co., Star Electric Lamp Co., and Waddell-Entz Co.

THE VREELAND PIT JACK AND MOTOR LIFT.

All railroad men recognize the necessity for the occasional removal of locomotive drivers and trucks, but have lacked a tool which is safe, expeditious and at the same time not too cumbersome and expensive. In the accompanying illustrations, Fig. 1, shows a device for solving this problem, manufactured by the W. & S. Hydraulic Machinery Works, of 204 to 210 East 43d street, New York.



Figs. 1 and 2.—The Vreeland Pit Jack and Motor Lift.

The advantages claimed for this invention are that the engine is not disturbed from its regular height; there is no jacking up first one end of the engine and then the other until the drivers will roll out under the tail-piece, and then obstructing the work underneath and the floor around by girders and blocking. There are neither cumbersome and expensive drop tables nor large steam hoists, and no floor space is required for the tool.

The illustration shows that the working part of this device is a specially designed hydraulic jack mounted on a track which crosses the regular pit at right angles. All working parts of this jack are designed so that they can be gotten at easily without disturbing any other parts. The top of the ram has a semi-cylindrical head in which the axle rests and in which it may be revolved so that it can be dropped on a track running at any angle with the pit.

Fig. 2 shows the Vreeland electric motor lift, a modification of the transfer pit jack, which has lately been introduced to electric railroad companies for lowering the motors from underneath the cars, and, when the car is out of the way, raising them again to the floor level. It has a single plunger pump with power of four tons and a movement of three feet, and is a reliable and easily worked tool. A small four-wheel truck rests on the head of the ram, which enables the operator to roll the motor off on the floor and to any part of the shop. The lift is also mounted on wheels when it is desired to use the tool in a long pit. The length of the cylinder below the base is four feet three inches, and the distance from base to cap twenty-four inches.

THE DAY COMBINED MESSENGER AND AUTOMATIC FIRE ALARM SYSTEM.

On Saturday, Nov. 18, a press exhibition was given of a system intended to afford a means of summoning messengers, combined with an automatic fire alarm. The system which is being exploited by the Automatic Fire Alarm Company, at 59 Liberty street, is the invention of Mr. Willard G. Day who has secured a number of patents on it, notably one on the employment of a warpable material applied to the thermostat. The messenger system does not differ materially from that in general use at the present time, and is so arranged that when the box is pulled the call number is sent in once. The thermostats forming part of the fire alarm system are in circuit with an auxiliary magnet placed within the messenger call box. When the thermostat closes its circuit, owing to an increase in temperature, the box sends in its number a dozen or fifteen times in succession. In this way the messenger calls are distinguished from the fire calls.

At the same time that the fire alarm is sent in, a drop falls in an annunciator on the premises, thus indicating the exact location of the fire. The system is a very simple one and ought to find a ready application.

THE WADDELL-ENTZ COMPANY.

Mr. J. Holt Gates, western manager of the Waddell-Entz Company, reports the sale of a 1,200-light generator, direct-connected, to the Hartford Safety Deposit Building, a 1,200-light generator, direct-connected to an Erie-Ball engine, to Messrs. Willoughby, Hill & Co.; a 100 h. p. railway generator, connected to an Ideal engine, to the South Chicago Street Railway Co., and two 600-light generators, direct-connected to Ball & Wood engines, to the Minnesota School for Feeble-minded, Faribault, Minn. The installation of the three large direct-connected machines to the West Chicago Street Railway Co. have been commenced and will probably be in operation in thirty days. In addition to these, orders for three 80 k. w. direct-connected machines have been received besides three 80 k. w. machines, direct-connected.

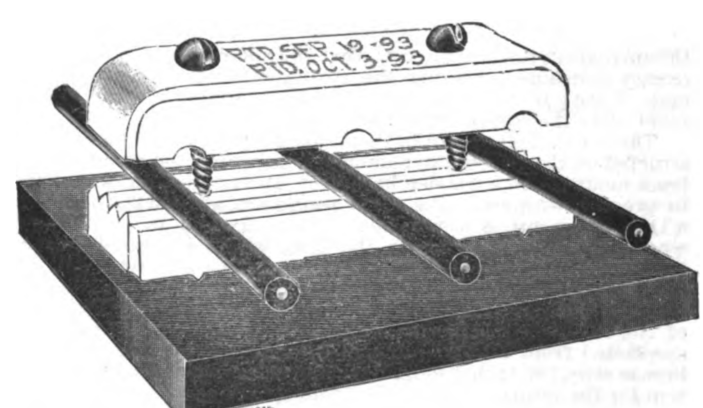
The Waddell-Entz Company build direct-connected dynamos from 15 k. w., at 350 revolutions, up to 1,000 k. w., at 70 revolutions. From 200 k. w. up the dynamos will be connected to Corliss engines, the armatures taking the place of the fly-wheel altogether. Mr. Gates further reports a good deal of interest in the Waddell-Entz copper and steel storage battery.

MR. R. SCHEFBAUER.

Mr. R. Schefbauer, of Paterson, N. J., reports business to be unusually active with him. He is making a specialty of equipping silk factories with electric lighting plants, and has recently been engaged in overhauling a number of such plants which have been reported unsafe by the insurance inspectors. Among recent work of this kind is the mill of Hitchcock & Meding, which has been entirely rewired for 1,200 lights with new porcelain cleats and sockets. Among new work is the mill of John Hand & Son, of Lake View, N. J., in which there have been installed 600 incandescent lamps and 20 arc lights of the General Incandescent Arc Light Company's make, together with switch boards. This, by the way, is the first silk mill in Paterson in which the winding room is illuminated by arc lamps. The five ampere lamp is employed, run two in series across the 110 volt circuits. At Lodi, N. J., the Alexander Dye Works have been equipped with 100 incandescents and eight arcs. Mr. Schefbauer's work has been highly recommended by the underwriters and is in marked contrast to that which prevailed in some of the mills which were wired some years ago.

THE B. AND D. CLEAT.

The accompanying illustration shows the "B. & D.," or Buffinton and Dow cleat, made by E. W. Buffinton, Fall River, Mass. With this cleat very rapid and neat work can be done. As



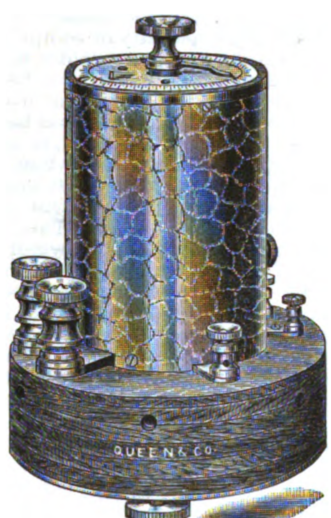
The B. & D. Cleat.

the wires are held taut, with but slight pressure of the screws on the cleat, the pressure required to firmly hold the wires in position is so slight that no cleats are broken by the wiremen while securing them to the walls. This feature is of great importance as it is a fact well-known to wiremen that there is apt to be a great loss by breakage. These cleats comply with all the rules and requirements of insurance inspectors or electrical engineers and are fully protected by patents.

NON-INDUCTIVE WATTMETER FOR DIRECT CURRENTS.

A DYNAMOMETER wattmeter constructed so as to work satisfactorily on alternating current circuits will work with equal satisfaction on continuous current circuits. The reverse, however, is not true. Masses of metal in proximity to the moving parts introduce no errors in continuous current measurements but in alternate current measurements their presence becomes fatal. Aside from a metal case, small pieces of metal near the system and even the binding posts on the outside are likely to introduce serious errors. Not only this, but the inductance and capacity of the fine wire or potential circuit must also receive consideration.

An electro-dynamometer of the Siemens type when employed on continuous currents gives readings proportioned to the square of the current, i^2; when employed on alternating currents it gives readings proportional to half the square of the maximum value of the current, $\frac{I^2}{2}$. Employing the same instrument as a wattmeter to measure the energy consumed by a circuit carrying a continuous current,—the one coil known as the current coil being placed in series with the circuit to be tested, and the other, known as the pressure coil, in shunt to the same circuit, a sufficient amount of extra resistance being added to it in series if necessary,—the readings become proportional to the product of the currents in the two circuits, that is, to $K\,r\,i\,i' = i\,E = W$, the energy consumed; r being the resistance of the fine wire circuits, i' the current in the same, K the constant for the instrument and i the current in the series coil.



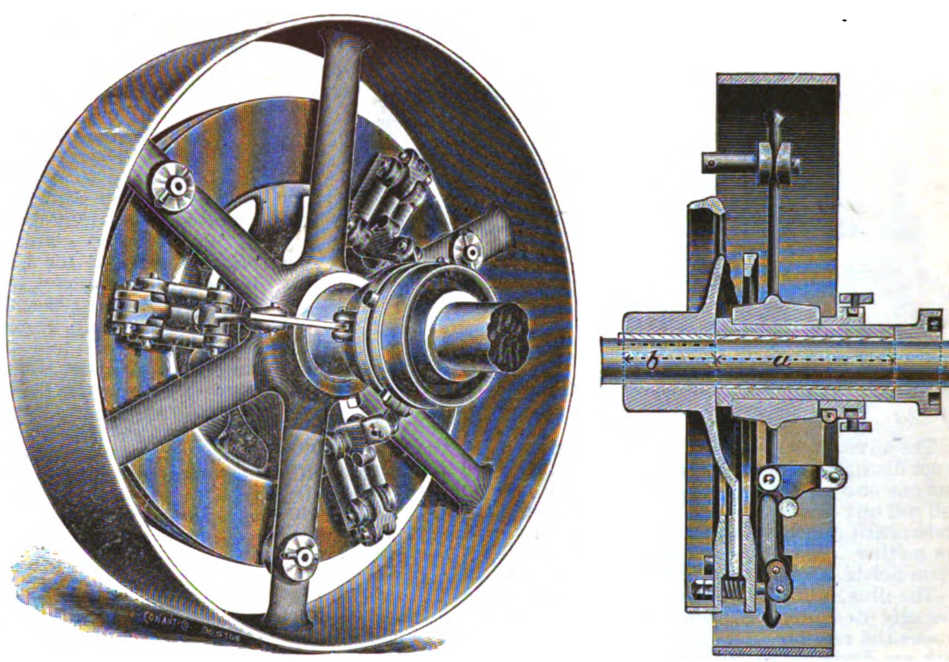
NON-INDUCTIVE DIRECT CURRENT WATTMETER.

The instrument shown in the accompanying engraving is constructed on the inclosed dynamometer principle, the case being of brass mounted on a wooden base built up of a number of sections to prevent warping. The extra resistance, about 8,000 ohms for a 110 volt circuit, is wound non-inductively and in sections on wooden spools placed inside the base, which is suitably ventilated. Within the case, half of which may be easily removed, are to be found both the fixed and movable coils, the latter coil consisting of from 100 to 200 turns depending on the range desired, of No. 34 copper wire wound on a light mica form. This coil is suspended from a rigid support by means of a fine phosphor bronze strip 1¼ inches long, a spring being provided at the bottom for the return current. Suitable guides and a clamping device are provided, the former to prevent the coil from being used when slightly out of centre, due to improper leveling. A spiral spring attached to the torsion head serves as the control. The upper end of the pointer attached to the system plays over the zero of the scale, the same as in the dynamometer. The use of mercury being entirely avoided, renders the instrument perfectly portable, and the employment of a large amount of extra resistance along with the delicately constructed and suspended system reduces to a minimum the power consumed by the wattmeter itself and at the same time leaves it quick to respond to any change in the power being measured. In order that the instrument may be applicable throughout a wide range of current, two pairs of fixed or current coils are provided, one pair consisting of ten turns each with a carrying capacity of 25 amperes, and the other of one turn each with a carrying capacity of 250 amperes wound over the other coils. Thus, either 25 or 200 amperes may be made to effect a complete revolution of the torsion head. The potential circuit may be made applicable to the higher voltages by the mere insertion of additional extra resistance. Queen & Co., Incorporated, Philadelphia, are the makers of the instrument.

THE IMPERIAL FRICTION CLUTCH.

THE accompanying illustrations show the "Imperial" friction clutch pulley made by J. W. Penfield & Son, of Willoughby, Ohio. The device, as will be seen, has a friction disc between two friction rings, the former keyed to the shaft and latter with the rest of the pulley, loose upon it under normal conditions. When the clutch is thrown in, the rings are clamped firmly against the disc and control the pulley immediately. The friction surfaces are protected against wear by strips of insulated fibre which may be readily replaced at any time, and the bushings, being made in halves, are also renewable at will and may be rebabbitted without removing the pulley.

As in this pulley the resistance is in the direct line of the strain, centrifugal force does not tend to exert a twisting strain and throw the clutch members out of balance, nor can it accidentally set or loosen the clutch, and hence the pulley may be safely run at very high speeds.



THE PENFIELD IMPERIAL FRICTION CLUTCH.

It will be noticed that this device is simple in construction and occupies but little space on the shaft. Besides this it is well made of the best materials and has given good service wherever used.

W. R. FLEMING & Co., New York and Boston representatives of the Harrisburg Foundry and Machine Works report the following sales for this month: Two 60 h. p. Ideal engines for the Hanover Fire Ins. Co., N. Y.; two 100 h. p. Ideal engines for the American Express Co., N. Y.; two 175 h. p. Ideal engines to the State Asylum for the Insane, Morristown, Penn. All the above are to be direct connected to dynamos. One 40 h. p. standard Ideal engine to J. & J. Rogers Co., Ausable Forks, N. Y.; two 60 h. p. standard Ideal engines, for the Brazilian warship *Nictheroy*, one 40 h. p. Ideal engine, Brooklyn St. Ry. Co., Brooklyn, N. Y.; two 50 h. p. engines for the General Electric Co., N. Y.; 160 h. p. Harrisburg high pressure boiler plant for the H. W. Johns Co., South Brooklyn, N. Y.; one 150 h. p. high pressure boiler plant for the N. Y. and Pa. Co. Messrs. Fleming & Co. report that most of the work in their shops at present is for direct connected engines.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE

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A SIMPLIFIED METHOD OF CALCULATING DYNAMO OUTPUT AND PROPORTIONS.—I.

BY

Cecil P. Poole.

ARMATURES.

Numerous formulæ have been advanced for the predetermination of armature output, but, owing to the character of the factors therein involved, it becomes necessary to go over the whole calculation for every change in size or output of an armature. With a view to obviating this tedious procedure the writer has devised a method which admits of considerable saving of time and is practical and accurate, though differing essentially from other methods. The points of divergence from common practice are :

1. The adoption of a fixed ratio between the cross-sectional area of the field magnet core and the diameter × length of the armature core.
2. The expression of the armature speed in peripheral velocity instead of revolutions per minute.
3. The basing of all calculations upon the magnetic density in lines per square inch instead of upon the total flux per given magnet core.
4. The division of the fundamental formula for armature output into two formulæ, the one containing those values which, by virtue of the preceding points, remain constant; the other embodying all factors which vary with the size or output of the armature.

The advantages to be obtained from the use of this system in everyday work are :

1. With a given armature core and magnetic density in field magnet core each armature conductor will cut a fixed number of lines of force irrespective of the number of poles on the machine, and the E. M. F. generated by the armature will be directly proportional to its diameter × length. This renders very simple the correction of preliminary, assumed dimensions.
2. The value of the speed factor may remain constant when once determined, so that it need be taken into consideration only once for a given line of machines.
3. Having once obtained the most suitable density at which to work the field magnet iron we have a factor which remains constant for all machines of a given class, irrespective of the size or output; whereas the use as a factor of the total flux per magnet pole entails recalculation of that factor and, consequently, of the entire formula for every size of machine.
4. Having two constant factors—density and velocity—the numerical values of which are the bulkiest in the formula, they are calculated but once, and the elimination of them from the formula leaves a very simple equation composed of small values, the convenience of which will be apparent upon following out this article.

Experience has demonstrated that good proportions are obtained when the plane area of each pole face is represented by $\frac{D}{p}L$, where D is the diameter of the armature core, L its length, and p the number of *pairs* of magnet poles on the machine. This holds good for machines having either drum or Gramme armatures.

Therefore, the cross-sectional area of the field magnet core for salient pole magnets may properly be represented by

$$fs = \frac{D}{p} L \quad . \quad . \quad . \quad . \quad . \quad . \quad (1).$$

Where the field magnet core is given this proportion the following formula will give the E. M. F. generated in an armature connected up in the ordinary manner :

$$E = \mathbf{B}'' \frac{D\,L}{p} N_w \frac{r.p.m.}{60} 10^{-8} = 0.166\ \mathbf{B}''\,D\,L \frac{N_w}{p} r.p.m.\,10^{-8};$$

where $\mathbf{B}''$ is the number of C. G. S. lines per square inch in the magnet core, N_w the total number of wires counted around the outside of the armature, and *r. p. m.* the number of revolutions per minute.

Now, as $D \times r.p.m.$ equals $3.8197 \times$ the peripheral velocity of the armature in feet per minute, we can drop D and *r. p. m.* and substitute $3.8197 \times S$ (S being the peripheral velocity) and the formula reduces to

$$E = 0.63\ \mathbf{B}''\,S\,L \frac{N_w}{p} 10^{-8} \quad . \quad . \quad . \quad (2).$$

The amount of calculation necessary for each size of machine will be greatly diminished by dividing this formula into two expressions, terming the one the "preliminary formula" and including in it the constant factor $\mathbf{B}''$ and the constant 0.63, and calling the other the "working formula" and embracing in it all variable values, together with a constant representing the product of the "preliminary formula." Thus, we can write for the working formula

$$E = k\,\frac{S\,L\,N_w\,10^{-4}}{p} \quad . \quad . \quad . \quad . \quad (3),$$

in which $k = 0.63\ \mathbf{B}''\ 10^{-4}$ . . . . (3*a*),

the latter constituting the preliminary formula referred to.

For multipolar machines having two-circuit armature windings such as the Andrews, Mordey, Westinghouse (railway), etc., and for the ordinary bi-polar machines the working formula becomes

$$E = k\,S\,L\,N_w\ 10^{-4} \quad . \quad . \quad . \quad . \quad (4),$$

the preliminary formula remaining as expressed by (3*a*).

Now, by adopting a constant peripheral velocity and transferring the factor S to the preliminary formula we may write for the working formula the very simple equation

$$E = K\frac{N_w}{p}L, \quad . \quad . \quad . \quad . \quad . \quad . \quad (5),$$

and for the preliminary formula

$$K = 0.63\ \mathbf{B}''\ S\ 10^{-8}, \quad . \quad . \quad . \quad (5a),$$

thereby embodying in the latter the bulk of the total calculation. For two-circuit armatures the working formula is still further reduced to

$$E = K\,L\,N_w \quad . \quad . \quad . \quad . \quad . \quad . \quad (6).$$

The difference between the amount of calculation necessary *per machine* by this method and that required by the

ordinary practice, as well as the facility with which preliminary armature dimensions can be corrected, may be demonstrated by a practical example.

Let us suppose that it is desired to lay out a line of four-pole incandescent dynamos, the voltage at the brushes to be 125, the armature a Gramme with the winding ordinarily connected (four parallel circuits through the armature), and the speed moderate. The field magnet to be salient pole, and of cast iron.

The armature being, say, smooth core, the peripheral velocity should scarcely exceed 3,000 feet per minute, and 2,500 would be much more comfortable. Having made tests of the field magnet iron and found, for example, that the best average results were obtained with a density of 48,000 lines per square inch of cross-section, and adopting 2,500 feet, for instance, as the peripheral velocity, we find from preliminary fromula (5*a*) that

$$K = 0.63\ \mathbf{B}''\ S\ 10^{-9} = 0.075,$$

which gives for our working fromula

$$E = 0.075\ \frac{N_v}{p}\ L.$$

Suppose we wish to get at the dimensions of a 5 k. w. machine. The armature current will be 40 amperes total, or 10 amperes in each conductor, if we ignore the small quantity of current required by the shunt field winding. We can therefore use No. 14 wire, B. & S. gauge for the armature conductor. Assuming, say, 72 commutator segments and four turns of wire per coil, then N_v will have a value of 288. Transposing the factors E and L in the equation we have, as giving the length of the armature core,

$$L = \frac{E}{0.075\ \frac{N_v}{p}} = 11.6 \text{ inches.}$$

Having 288 wires around the armature, if these are disposed in a single layer the circumference will have to be 21.6 inches, the diameter of the wire over the insulation being practically 75 mils. This would give the armature core a diameter of 7 inches, which is manifestly out of proportion to the length of 11.6 just obtained, for a four-pole machine. Now, if we know what ratio we wish the length of the armature core to bear to its diameter the dimensions may be corrected without reference to the preceding formulæ, by the use of the following equation:

$$L' = \sqrt{\frac{D\ L}{L' : D'}}, \quad \ldots\ldots \quad (7),$$

where the diameter and length first obtained are represented by D and L respectively, the corrected length by L', and the desired ratio of length to diameter by $L' : D'$. For four-pole machines it is common practice to make the length of the armature core about half its diameter, varying from that up to equality. Assuming, for example, that the designer wishes the ratio of length to diameter to be as 1 to 2, then the corrected length of the armature core will be

$$L' = \sqrt{\frac{7 \times 11.6}{2}} = 6.375 \text{ inches,}$$

and the corrected diameter will of course be $L' \times 2 =$ 12.75 inches. The value of N_v will have changed along with the diameter, but the E. M. F. of the armature will remain unchanged by the correction. The corrected diameter of 12.75 inches will give a circumference of 40 inches which will accommodate 533 No. 14 wires, but this being an unwieldy number one would reduce it to 528 and use 66 commutator segments, giving 8 turns per coil.

To prove the result after correction we can fill in the new values and find by working formula (5), that

$$E = K\frac{N_v}{p}\ L' = 0.075\ \frac{528}{2}\ 6.375 = 126.2 \text{ volts,}$$

the excess of 1.2 volts being due to allowances made in the several calculations in place of carrying out the decimals.

Of course, the armature just calculated is not put forward as an ideal one; the dimensions were taken haphazard, merely to illustrate the application of the method. It is manifestly unnecessary to take the result of formula (7) as being inflexible; the only essential point is that in order to make changes in the diameter and length of the armature without going back over the formula for output, and *without altering the output in making such changes*, one must satisfy the equation $D' \times L' = D \times L$.

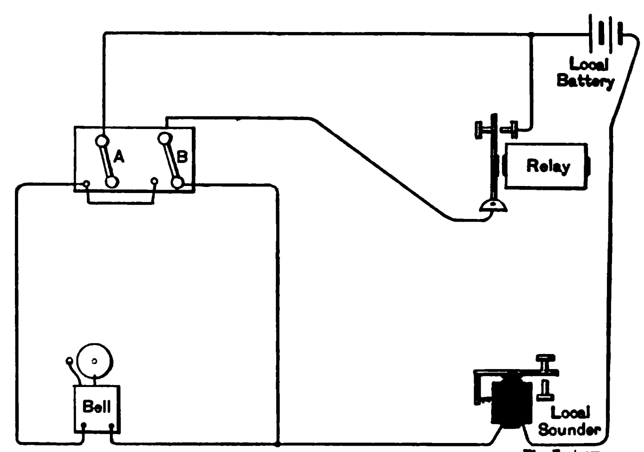
The rapidity with which preliminary calculations can be made and assumed values corrected when one becomes entirely familiar with this method is marked, and can be better experienced than described.

A SWINGING GROUND TESTER.

BY

D. B. Grandy

For the benefit of "wire chiefs," and others in the telegraph service who, like myself, have doubtless put in many



THE GRANDY SWINGING GROUND TESTER.

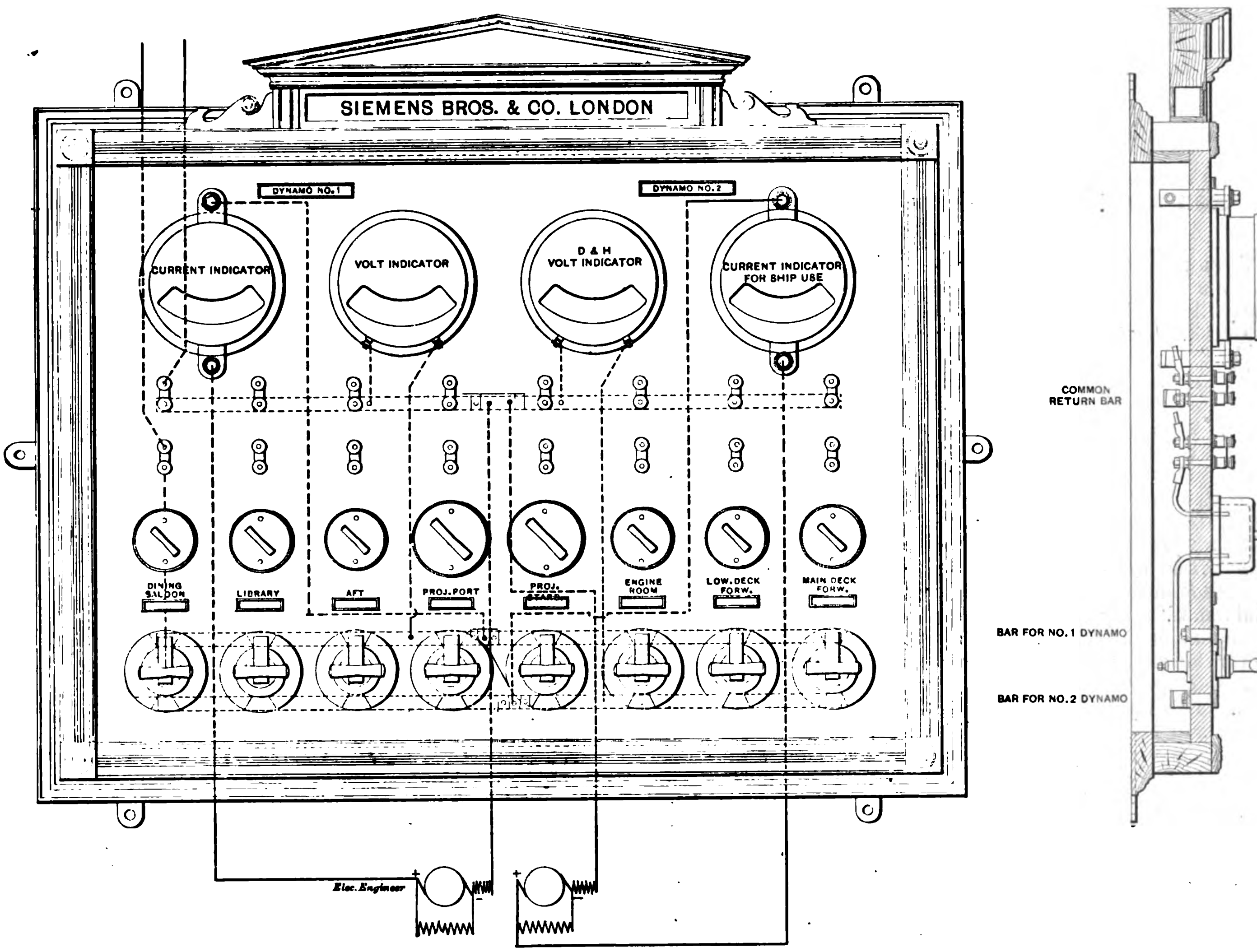
an hour watching a relay for the click of a swinging ground, I give herewith an arrangement which I put in use a year ago, and which has saved much time in testing for wire troubles.

As will be seen, in the accompanying diagram, it is a device by which either the opening or closing of the relay points, as desired, rings a bell in the local circuit. One of the testing sets at the switchboard is arranged with a double 3-point switch, as shown, the normal position of the springs being to the right, when only the sounder is in circuit. By turning switch B to the left, the bell is thrown into the local circuit and rings when the relay *closes*. If switch A is turned to the left, switch B remaining to the right, the bell is rung by the *opening* of the relay points. Thus, in testing for a "swing," the relay is placed in the wire to be tested, the switch B turned to the left, and the wire chief can go about his other duties, knowing that every time the "swing" comes in, the bell will ring. Again, if a wire is grounded and it is desired to know the moment it is cleared, battery is put to the wire, the relay cut in, the switch A turned to the left, and as soon as the ground is removed, the relay opens and the bell will ring. The device is easily arranged, and will be found a great convenience.

ELECTRICITY ON BOARD THE VANDERBILT STEAM YACHT "VALIANT."

The departure of the twin screw yacht *Valiant*, owned by Mr. W. K. Vanderbilt, from these shores for an extended cruise in the Mediterranean and the East Indies for some months, was an interesting event to many persons who had gathered at the Fiftieth street pier, North River to bid her passengers farewell and bon voyage.

The *Valiant* has the distinction of having the largest electric light installation of any private pleasure craft in the world. The equipment of the electrical apparatus was carried out by Siemens Bros., Ltd., of London, and consists of two compound wound dynamos of a rated capacity of 16 k. w. each, coupled directly to vertical compound engines running at a speed of 280 revolutions per minute. The dynamos are of the Siemens type with drum armatures. The mains from the generators are led to the massive slate switchboard shown in the engraving. The wiring is in eight circuits, using a return wire, and not, as in the case of the majority of vessels wired in England, using the iron skin of the hull as the return. Throughout the yacht are over three hundred 16 candle power incandescent lamps of one hundred volts, as well as two electric search lights of 25,000 candle power each placed on the port and starboard sides of the bridge. The mast head and side lights have in their respective lanterns two 32 candle power incandescent lamps so arranged that if one is extinguished the other is lighted automatically. All the sockets are of the United States Navy standard and were sent over specially from this country. The electric fittings in the library, dining and drawing rooms are very beautiful and tasteful and were designed in Paris. The globes covering the lamps are of rich cut glass. In the state rooms the lamps are placed in silver fittings and the light is softened by covering the globes with delicate silk shades. In convenient places on the panels in the saloons and state rooms have been placed key receptacles to admit attachment plugs connected directly by silk flexible conductors to Lundell fan motors furnished by the Interior Conduit and Insulation Company.



Electric Light Switchboard on the Vanderbilt Steam Yacht "Valiant."

The yacht may be briefly described as a steel vessel, brig rigged, 325 feet long, 39 feet beam and 19 feet mean draft. The twin screws are propelled by two triple expansion engines, cylinders 23, 36 and 55 inches in diameter by three feet stroke, indicated h. p. 4,500, running at 150 revolutions per minute under a steam pressure of 180 pounds supplied by three horizontal return tubular boilers. She can steam 18½ knots per hour under forced draft. Apart from these main engines there are thirty-two other engines in the ship used for pumping, ventilating, condensing and other purposes.

The engines that drive the dynamos are of the Belliss vertical compound type, each of 25 h. p., and are mounted on a massive cast iron base. The engines and dynamos present an exceedingly neat and compact appearance, oc-

cupying, as they do, the whole of one side of the engine room on the main deck and all the parts requiring lubrication and inspection are readily accessible. Great care has been given to the proper wiring of the vessel. Siemens high grade insulation cables are used throughout, and the wires are run in special mouldings between the skin of the ship and the carved paneling, to the various cut-out boxes and safety devices located in convenient places.

The vessel was built and engined by Laird Bros. of England. She takes the place of the yacht *Alva*, owned by Mr. Vanderbilt, which was run into and sunk while at anchor in the Sound during a fog some two years ago.

The *Valiant* is owned by a limited liability company with a capital of £100,000 in one pound shares. Mr. Vanderbilt holds all the shares with the exception of seven which are held by other stockholders necessary in the formation of a limited liability company: Mr. Vanderbilt is also governing director of the company. The idea of forming this company is to remove from Mr. Vanderbilt the liability in case of collision or other damage to another vessel, and to place it with the company whose only assets are the yacht and its fittings.

Mr. W. H. Fleming, E. E., manager of the International Trading and Electric Co. which furnished all the incandescent lamps, sockets and fans installed on board and all the necessary electrical supplies, states that without doubt the *Valiant* is a vessel whose electrical equipment surpasses that of any other now afloat.

WORLD'S FAIR DEPARTMENT.

CARD MOTOR OPERATING A LODGE & DAVIS DRILL.

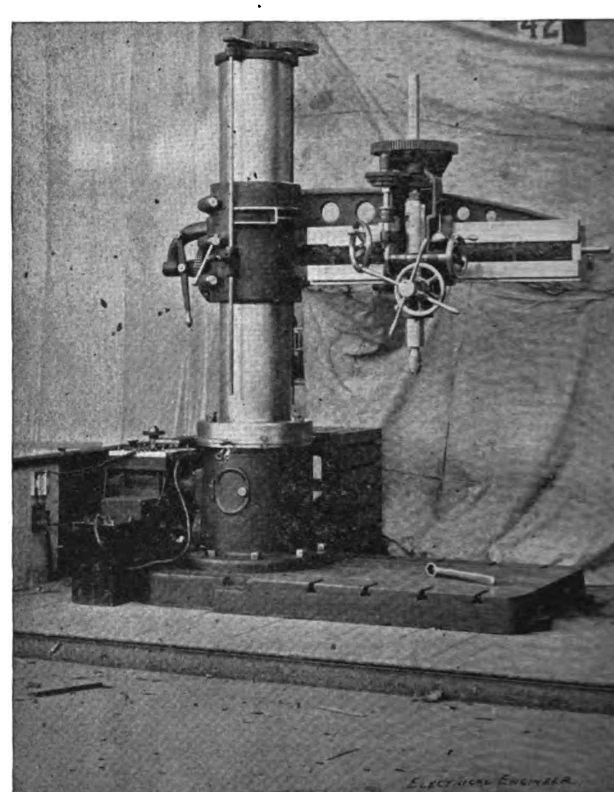
There were a great many interesting exemplifications of the use of electric motive power at the Fair, but not so many illustrative of direct tool driving as might have been expected. This branch of work grows daily in extent and importance, and it would seem that no better opportunity could have been selected to impress the builders and users of machinery with the numerous advantages of electric motors when employed in the factory or machine shop.

Be this lack of general appreciation of the opportunity due to whatever cause, it must be said that the instances presented were highly suggestive and instructive. We illustrate herewith, for example, a combination which had a prominent place, standing as it did in the front row of the superb tool and machine exhibit, in Machinery Hall, of the Lodge & Davis Co., of Cincinnati. Our cuts shows the compactness of the arrangement faithfully. One has to look carefully for the motor before its presence is noticeable. The tool driven is a 5 by 6 foot Lodge & Davis improved plain radial drill. The motor was built for it by the Card Electric Motor and Dynamo Co., of Cincinnati. It is plain shunt wound, two pole, iron clad, with Gramme ring armature, and wound for 10 amperes at 500 volts. It not only turns the spindle, but also works the arm up and down the column, with a special arrangement for starting, stopping, reversing and changing speed, attached to the top of the column pedestal. This arrangement makes it very handy to operate from any part of the press, especially in the case of work that is to be drilled and tapped. By moving a handle on either side of the drill press, the operator can get any speed on the motor at will, ranging from 100 up to 600 revolutions per minute. This gives the press a range running from ½ inch up to a 2½ inch hole.

It may be mentioned that the two essentials aimed at in the drill, and which the use of the motor tends in nowise to counteract or detract from, are the stiffness of the arm and the rigidity of the column. In these drills the columns are of great weight and extra large in diameter. The lower part turns in an outside sleeve of increased diameter, which envelops the column to nearly one-third of its entire height.

The arm is raised and lowered by the motor and has great stiffness, having an extra long bearing on the column. The face on which the saddle for head travels, is of extra width.

The driving cone is placed at the base of the drill, allowing it to be driven by a long belt direct from the countershaft without bevel gears. The vertical driving shaft is placed in the centre of the column, and receives its motion through a pair of mitre gears from the cone pulley shaft. The bracket carrying the bevel gears which slide on the vertical shaft, is attached to the swinging arm and traverses



Card Motor Operating a Lodge & Davis Drill.

in a slot provided in the rear of the column. Through this slot projects a short shaft driven from the inside bevel wheels, carrying a pair of spur gears of different diameters, engaging alternately with the gears on the back shaft at the rear of the drill. By this arrangement the change of speeds is made rapidly, at the same time bringing the driving gearing close to the spindle.

The spindle is of extra diameter, and provided with the Lodge & Davis patent quick return.

The entire internal driving mechanism is accessible from the outside, and can be taken apart without taking down the drill.

The column revolves with the greatest ease by means of

steel balls. The thrust of the spindle is taken by Ross antifriction steel ball bearings, eliminating a large proportion of the friction. The thrust on the elevating screw is taken in the same manner. This machine is constructed so that it may be used for tapping. An improved box table is provided, as shown. The double-friction countershafts have pulleys 18-inches in diameter for a 5-inch belt, and run at 200 revolutions per minute.

Such a combination as this, must, it seems to us, grow rapidly in popularity, and come into general use.

THE DE LAVAL STEAM TURBINE.

ONE of the most interesting exhibits, although a small one, in the Machinery Hall at the World's Fair was that of the De Laval steam turbine, invented by Dr. Gustaf De Laval, of Stockholm, Sweden. This machine includes a number of principles entirely new in steam engine design, one of which is that the steam is made to fall to the same pressure as the surrounding atmosphere before it reaches the wheel, and thus its whole energy is utilized as momentum.

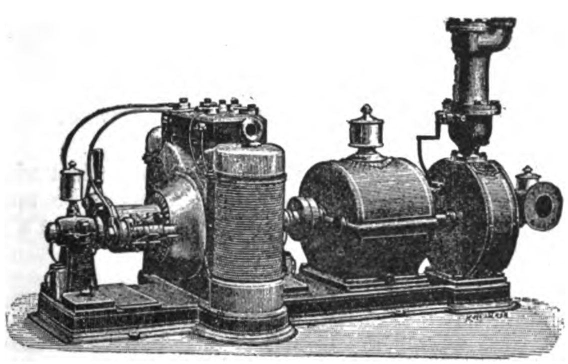
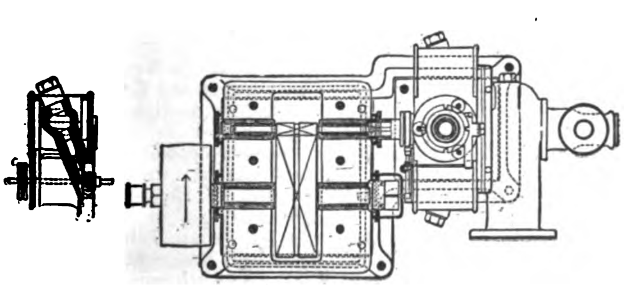


FIG. 1.

In the accompanying illustrations, Fig. 1 shows an external view of the steam turbine connected to a dynamo. Fig. 2 shows the nozzle which is so directed as to form a small angle with the blades of the turbine, and the angle of the blades is the same at both sides. The expansion of the steam takes place in the nozzles and is effected by diverging the sides of the passage before reaching the wheel. Its volume is therefore increased, as well as its velocity and momentum, and the greater the expansion the greater the velocity becomes. A pressure of 75 pounds at the boiler expanded to an absolute pressure of one atmosphere at the wheel will give a final velocity of about 2,625 feet a second. If the expansion be continued to a pressure of 0.1 of an atmosphere the velocity will be about 4,600 feet. Expansion is thus carried much further than in reciprocating steam engines.

In Figs. 3 and 4 are shown, horizontal and vertical sec-



FIGS. 2 AND 3.

tional views of a five h. p. turbine. Steam enters through the pipes at the top of the turbine box, and is conducted through the steam channel to the two nozzles through which it is led to the wheel Thence it passes between the blades of the turbine wheel through holes in a separating plate to an exhaust opening at the back of the box and finally to the outer air. In this turbine the velocity of the periphery of the wheel is 574 feet a second and the wheel makes 30,000 revolutions a minute. In order to withstand

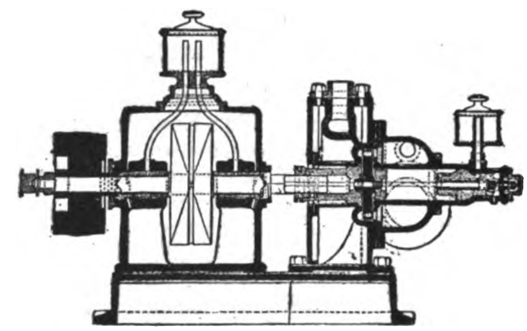


FIG. 4.

the strain of such an enormous speed the turbine is made of the very best quality of steel and the blades are cut in one piece with the body of the wheel, on a milling machine. A steel ring is then shrunk on the outside of the blades and prevents steam from passing over their ends. Notwithstanding the greatest care it is impossible in apparatus revolving at so great a speed to make the centre of gravity correspond exactly with the geometrical axis of revolution. In the De Laval turbine, however, this difficulty is solved by the use of a flexible shaft, shown in Fig. 5, which, when in operation, is actually thrown out of the centre and revolves about it. The free end of this shaft is provided with a ball fastening in the bearing to allow it to adjust itself automatically.

It is extremely unusual that a steam engine has to be geared down to adapt itself to a generator. This, however, is the case here. The speed is reduced from 30,000 to 3,000 revolutions a minute in the gearing box. The governor is attached to the inner end of the shaft of the larger gear wheel in the gearing box, and its revolution at a higher rate of speed than the normal causes weights attached to

FIG. 5.

it to revolve and cut off a portion of the steam, on the principle of the ball governor. A spiral spring keeps the weights at equilibrium at 3,000 revolutions.

The turbine shown in Fig. 1 is of 30 h. p. and the shaft is geared to two gear wheels. The dynamo has two armatures whose shafts are coupled directly to those of the gear wheels of the turbine. The turbine box contains eight nozzles, four of which can be opened or closed by independent valves as the power requires. This machine is intended to work with condensation; the nozzles diverge strongly toward the opening and the entire box is made perfectly tight.

The De Laval turbine certainly seems, by reference to the numerous tests, the results of which have been published, to hold its own very well in point of economy with engines now in general use. One of the most recent tests, conducted by a well-known engineer, upon a 50 h. p. turbine and dynamo combination, shows that 63.7 h. p. was obtained with a consumption of 19.73 pounds of steam and of 2.67 pounds of coal per h. p. hour. It is said that turbines of larger sizes have been proved to work with an economy of steam fully equal to that of triple expansion engines of corresponding size. Mr. Reinh. Hörnell is the representative of Mr. De Laval in the United States and is at present making his headquarters in this city.

ELECTRIC RAILWAY DEPARTMENT.

DR COLTON'S USE OF THE TRACK AS CIRCUIT IN 1847.

In the November 29 issue of THE ELECTRICAL ENGINEER[1] a very complete and exhaustive review was given of the Field electric railway litigation, one of the features of contention in which is the use of the track as part of the circuit, namely, "a circuit of conductors composed in part of an insulated or detached section of the line of rails as a railway, a wheeled vehicle movable upon or along said insulated section of track, an electromagnetic motor mounted upon said vehicles for propelling the same, and included in said circuit of conductors." The claim included also a circuit controlling device placed on the vehicle. In 1891, a patent was granted to G. F. Green, of Kalamazoo, Mich., now dead, on pretty much the same thing, his third claim including these words as to the circuit: "and consisting wholly or in part of the rails thereof." The review of the Field case given in these pages last week, embraces also the early work of Siemens and others, but it does not refer to that done in 1847 by Dr. G. Q. Colton, who in a modest but sufficient way did much that has nearly fifty years later become of great importance and interest.

The story of Dr. Colton's work and career was told so recently in these pages[2] that there is no occasion to go over it again now. But it is interesting to be able to report that the motor used by Dr. Colton in his lecture tours of 1847 has been found. It had lain all these years, neglected, shattered and dusty, in a lumber room at the Doctor's old homestead in Vermont, and now emerges to the light again to show the present generation how far ahead its ancestors thought, yet how crude the apparatus was with which they sought to carry out their ideas. The motor is now in the possession of this journal. Fig. 1 is made from a photograph taken of it and some of its *disjecta membra* a few days ago. Fig. 2 shows the motor upside down, in order to exhibit the cross connections by means of which current was led into and

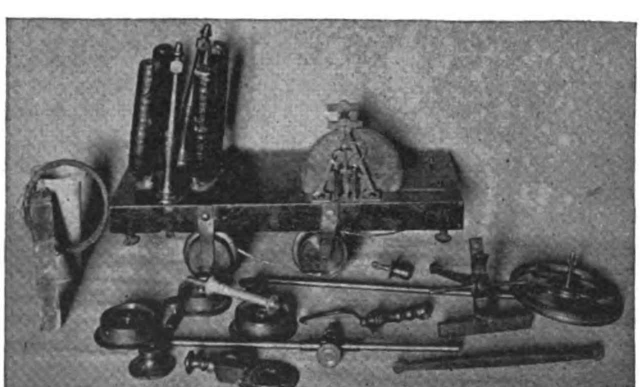


FIG. 1.—COLTON'S MINIATURE RAILWAY MOTOR OF 1847.

out of the car. This motor was operated, on a large wooden ring or felly about 8 feet in diameter, and the two rails consisted of thin iron bands along the upper edges of which the wheels ran. One band was connected to the battery across the stage, and then, when he was ready for the demonstration, Dr. Colton would connect another wire from the battery to the other rail or band, and thus close the circuit. Then the little train of four cars laden with miniature dummy passengers would race around the track, and everybody became enthusiastic on seeing how they

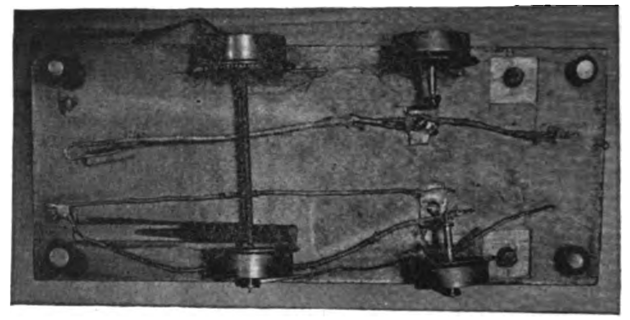


FIG. 2.—COLTON'S MINIATURE RAILWAY MOTOR OF 1847.

were going to travel when electricity was at last adopted as a motive power. These demonstrations were made a great many times, in a great many places, before a great many people.

1. ELECTRICAL ENGINEER, page 474, Vol. xvi.
2. "The Electric Railway Work of Dr. Colton in 1847.—The First Use of Track as Circuit." By T. C. Martin, E. E. No. 272, Vol. xvi., page 49 et seq., with portrait.

THE POWER REQUIRED TO DRIVE CANAL BOATS.

Now that actual work has been begun looking to the propulsion of canal boats by electricity, it is fair to assume that this field of operation will attract many who have given thought to this subject in the past, and others who will enter it, drawn to it by its promising nature. Among the problems to be solved is the power required to drive canal boats at given speeds, and on this point we are able to afford our readers some information taken from an article by Horatio Seymour, ex-state engineer of New York, who gave special attention to the state canals and who is considered one of the authorities of the world on this subject. This article, written in March, 1886, it will be noted, also emphasizes the importance of deepening the canals, a subject which is being agitated at present and which, it is to be hoped, will secure early attention by the New York State Legislature. The following is the extract:

In order to practically demonstrate the benefits of deeper water, I took the boat "Henry L. Purdy" and placing a dynamometer back of the horses, I found that, loaded to six feet in seven feet of water, moving at a speed of $1\frac{37}{100}$ miles per hour, the resistance was 292 lbs. I then took the boat into a portion of the canal that was 8 feet deep and found that, with the same tractive force of 292 lbs., the boat moved at the rate of $1\frac{44}{100}$ miles per hour, which would make a saving of 19 hours in time between Buffalo and West Troy.

The next year I made a trip from Buffalo to New York in the steamer "Emma" and consort, Captain Edward Hathaway. The canal from Buffalo to Lockport is 9 feet deep, and from Lockport to Rochester will average nearly 8 feet deep. The average time of the "Emma" and her consort between these points, after deducting the effect of the current, was $2\frac{}{10}$ of a mile per hour with an expenditure of fuel of $25\frac{7}{10}$ pounds of coal to the mile; while from Charles Bridge to the Richmond Aqueduct, where the water was less than 7 feet deep, the speed was only $1\frac{7}{10}$ mile per hour and the coal burned, $52\frac{8}{10}$ pounds per mile or 30 *per cent. less speed with more than twice as much fuel*. If the canal throughout was as deep as it is from Buffalo to Rochester, the running time could have been reduced at least seventeen hours with two tons less coal, or with the same amount of fuel I have no doubt that a saving in the time of twenty-four hours could have been effected."

We add here also an extract from the Annual Report of the Superintendent of Public Works on the Canals of the

State (New York) for 1891, by Mr. Edward Hannan, then as now superintendent, in which these points are also touched on. Speaking of the canals Mr. Hannon says:

They should, however, be made with a view to enabling boats with much larger cargoes to be navigated upon them, and with a further view to a more rapid delivery cf cargoes between the points of production and consumption, which also involves an increase in the motive power for the propulsion of boats over that which is now used upon the canals. The present style of boat upon the canal has not been improved for upward of thirty years (except in a small number of cases where steam canal boats have been introduced). These are capable of carrying 8,000 bushels of grain, equal to 240 tons. The boat is loaded to six feet in depth, leaving one foot of water under it. Owing to the accumulations of deposit which gather each year, there are many places where this one foot of water does not exist under the boat when loaded. The average rate of speed attained by these boats is between two and one-half and three miles per hour. With an additional foot of water under the boat, this rate of speed could be increased nearly fifty per cent. without any additional power other than that which is now employed to propel them.

FLEXIBLE CANAL BOAT TROLLEYS.

BY

Jno. Dennis Jr.

In some respects the supplementary trials of the pioneer canal boat, the "F. W. Hawley," at Pittsford, have been more satisfactory, from a technical view point, than the official trial in the presence of Governor Flower and the canal officials. One of the vexatious features of the official trial was the long delay incident to the difficulty in placing the heavily laden canal boat under the trolley wires. Even when the boat was fairly under way, extreme care in steering was necessary to keep the underrunning trolleys in position, and almost no variation from the course under the wires was admissible; and the services of a steam tug were required in making the turn, preparatory to the return voyage.

Early in the week following the official trial, I was invited by Mr. Charles R. Barnes, the electrician acting for the canal officials and Engineer Chesrown, of the Westinghouse Company, to visit Brighton and witness some experiments with improvised flexible trolleys. It was late when I arrived and the "Hawley" had been moored at the bank, but the Westinghouse engineer kindly ran the boat over the course for my benefit.

The flexible trolleys were extremely simple temporary devices and consisted of insulated copper wires, with hooks at the ends. The trolley arms had been removed and the wires were connected to the standards. The hooks were passed out to the trolley wires by means of a pike pole, and the motors, reversed, backed the boat out into the channel. It was then sent ahead regardless of its position under the trolley wires. In fact the antique dish-pan propeller might have been operated by steam, so far as the position of the boat in the canal was concerned. At my request the boat was steered from side to side, taking any desired position, no difficulty being experienced with the trolleys. It is doubtful if a loaded canal boat ever took such an erratic course on the waters of the Erie canal before. The instruments showed a pressure of 800 volts, that is, about fifty volts higher than the highest figure on the official trial, the current being somewhat less than on that occasion, leaving the electrical horse power the same; about twenty. The boat of course lacked its memorable deck load of passengers, but still carried its load of 175 tons of sand. The speed reached was fully four and one-half miles an hour, the shaft making sixty revolutions.

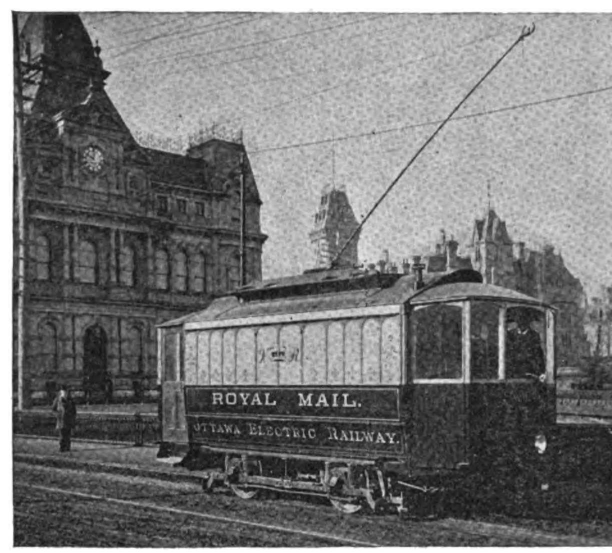
The process of manœuvering the boat in the basin at the turn was very interesting. By simple manipulation of the controller, going ahead and astern as required, the sluggish boat was turned without the aid of tug or pike pole. The return trip was quickly made and the boat was again turned without outside aid, and docked at the bank. The trolleys were again unshipped and coiled on deck.

While the Westinghouse engineers and electricians maintained a sphinx-like silence regarding the ultimate type of trolley to be used, it is probable that it will consist of an over-running carriage, easily removable in case it is desirable for one boat to pass another going in the same direction; these carriages being connected with the motor by means of a reel of flexible wire. The same reticence was manifested regarding the future canal boat motor, although it is scarcely possible that it has not already been determined upon. The statement that the high potential at Niagara Falls will be used, seems to suggest the employment of the Tesla alternate current motor. Certain it is that, while the experimental canal boat seemed to be analogous to a street car on land, this analogy was more apparent than real. The conditions of frequent starting with very heavy loads and quickly acquired momentum in the case of the street car, would seem to present an entirely different problem from the propeller wheel, which may churn the water at full speed from the outset with impunity, until the sluggish canal boat has gotten under way. Then there is the steady drag, with momentum an almost vanishing quantity in the equation. In fact, the start would seem to cut no figure, as the wheel will be doing after its kind in any event, whether the boat is moving or standing still, and there is no fluctuation in load, apparently, so far as the motor is concerned.

The "Frank W. Hawley" is now out of commission, and further experiments will be deferred until the opening of navigation in the spring.

ELECTRIC MAIL CARS IN OTTAWA, CAN.

A CONTRACT has been entered into between the Dominion Government and the Ottawa (Can.) Electric Street Railway Co. for the conveyance of the mails between the railroad stations and the post office at Ottawa city. This service has hitherto been performed by mail wagons drawn by horses, and while the service thus rendered appeared to be satisfactory its cumbersomeness compared with the new electric system is now apparent to all. The electric postal cars, as illustrated in the accompanying engraving, were made by the Ottawa Car Manufacturing Co., and equipped with 30 h. p. Westinghouse motors by Ahearn & Soper, the Canadian agents of the Westinghouse Electric & Mfg. Co. The cars are 20 ft. long and are mounted on Brill trucks. Doors for loading and unloading the mails are on the insides of the cars. The interior is fitted up in a convenient manner for handling the mails. The cars have gongs different in tone from those in use on the ordinary cars. The distance from the Post Office to the farthest railroad station is a mile and a quarter. The run is usually made in five or six minutes, while under the old system of horses the time occupied was never less than 20 minutes. The Postmaster-General and the Post Office officials are very much pleased with the change, and it is probable that a similar service will be put into operation in the other cities of the Dominion. Three cars are used in the service at Ottawa.



ROYAL MAIL CAR, OTTAWA, CAN.

SATISFACTORY STREET RAILWAY EARNINGS IN NEW ENGLAND.

THE gross earnings of the street railway companies controlled by the New England Street Railway Company for the month of September and for six months show: Month of September—New Haven, $17,385, increase, $1,944; Haverhill and Amesbury, $11,691, increase, $4,650; Plymouth, $3,036, increase. $464; Gloucester, $6,790, increase, $461; Natick, $2,426, decrease, $211. Total for the month, $41,330; increase, $7,309. The total gross earnings of the above companies for the six months from April to September inclusive were $265,442; increase, $77,233.

PROTECTING MOTORMEN FROM THE WEATHER.

THE Ohio newspapers have lately had a good deal to say about the construction of vestibules on the platforms of electric street cars for the protection of the motormen in cold weather, such protection being required by a law recently passed. A Tacoma paper states that such enclosures are being built upon the platforms of cars in that city at the expense of the motormen, three men paying $5 each ($15) for the work on each car.

THE EASTERN POWER STATION OF THE BROOKLYN CITY RAILROAD.[1]

The immense power station which the Brooklyn City Railroad Company is building in Williamsburgh, Brooklyn, at the corner of Kent and Division avenues, is now approaching completion, and presents a scene of great activity. The stack has been finished to the cap, and its graceful proportions have attracted a good deal of favorable comment. The power station building, which is of brick with stone trimmings, is enclosed and roofed; two of the engines, with their generators, composing one-third of the plant, are in place and have been run, and others are being installed. About ten of the boilers out of the total of thirty-six have been set, and the engineers are putting in the tubes for about an equal number of additional boilers. Pending the completion of the flues, installation of the economizers, etc., a temporary stack is being employed.

The design of the station was furnished by F. S. Pearson, of Boston, consulting engineer of the company, and the construction is now being carried forward under the direction of Chief-Engineer M. G. Starrett, of the Brooklyn City Railroad Company, assisted by F. B. Hall. The resident engineer, representing the General Electric Company, is J. U. Mahoney, and the engine builders are represented by W. M. Derby. The contractors for the iron work are the Boston Bridge Company, of Boston, and the contractors for the piping are Riter & Conley, of Pittsburgh, Pa.

The station occupies an irregular plot of ground, in its maximum dimensions 255 by 205 ft., one side located on the Wallabout channel. It is divided into four main departments, viz., boiler room, economizers and stack, engine room and general offices. These are separated from each other by walls two and three feet in thickness. The boiler house, which is three stories in height, is 142 ft. 6 ins. by 87 ft. 6 ins., and is on the side next the water. Here are eighteen batteries of two boilers each, located in two tiers, one directly above the other, as shown in Fig. 1. The boilers are of the Babcock & Wilcox type, and each battery is of 500 h. p. nominal capacity.

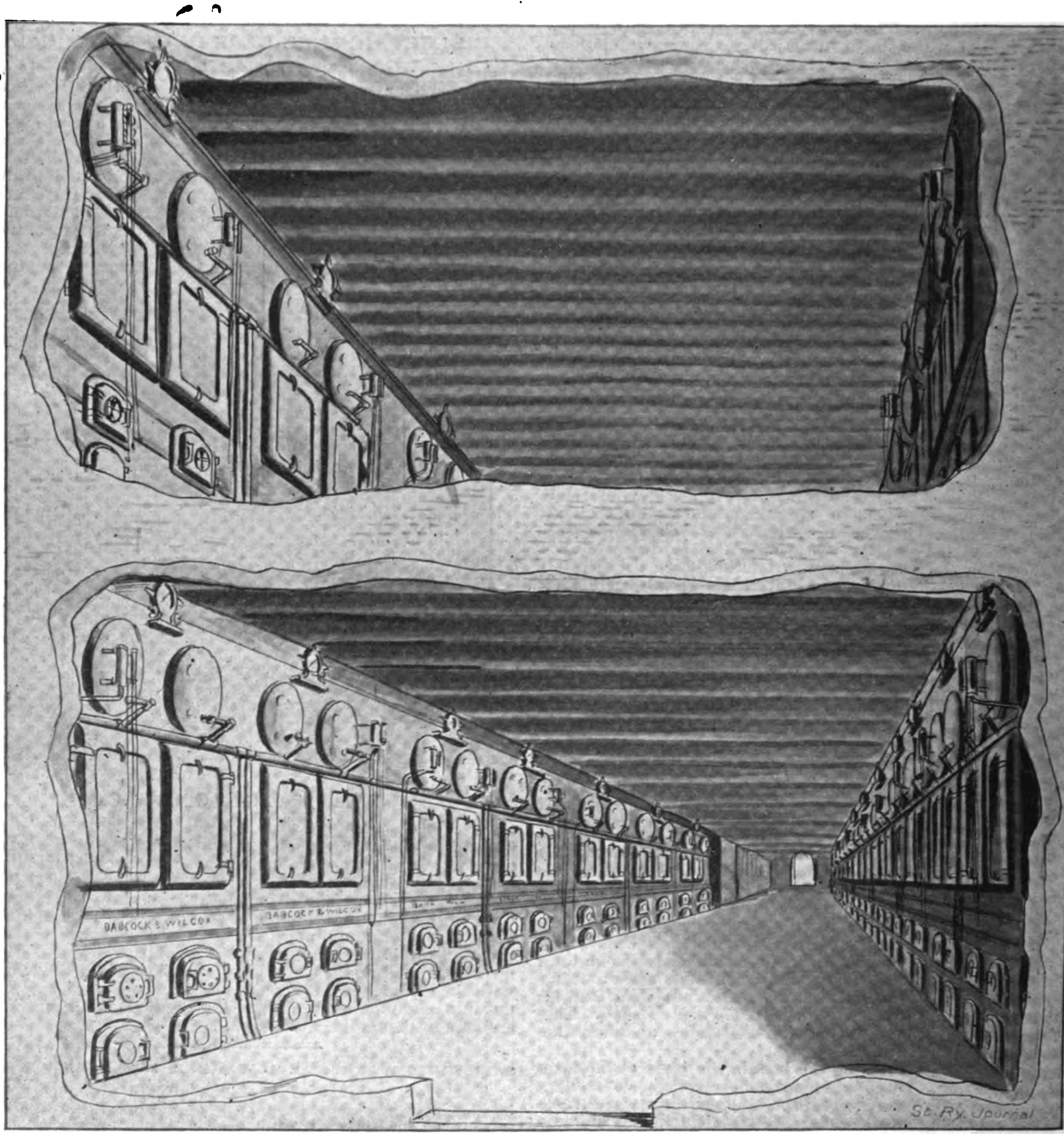


Fig. 1.—Double Tier Babcock & Wilcox Boiler Plant, Eastern Power Station, Brooklyn City Railway.

The C. W. Hunt system of automatic conveyors for fuel and ashes will be used. Coal will be taken by this means directly from the boats at the pier and conveyed to two large storage pockets in the upper part of the boiler house. These will have a total capacity of 6,000 tons. From these pockets the coal will be led by special chutes directly in front of the furnace doors,

1. *The Street Railway Journal*, December, 1893.

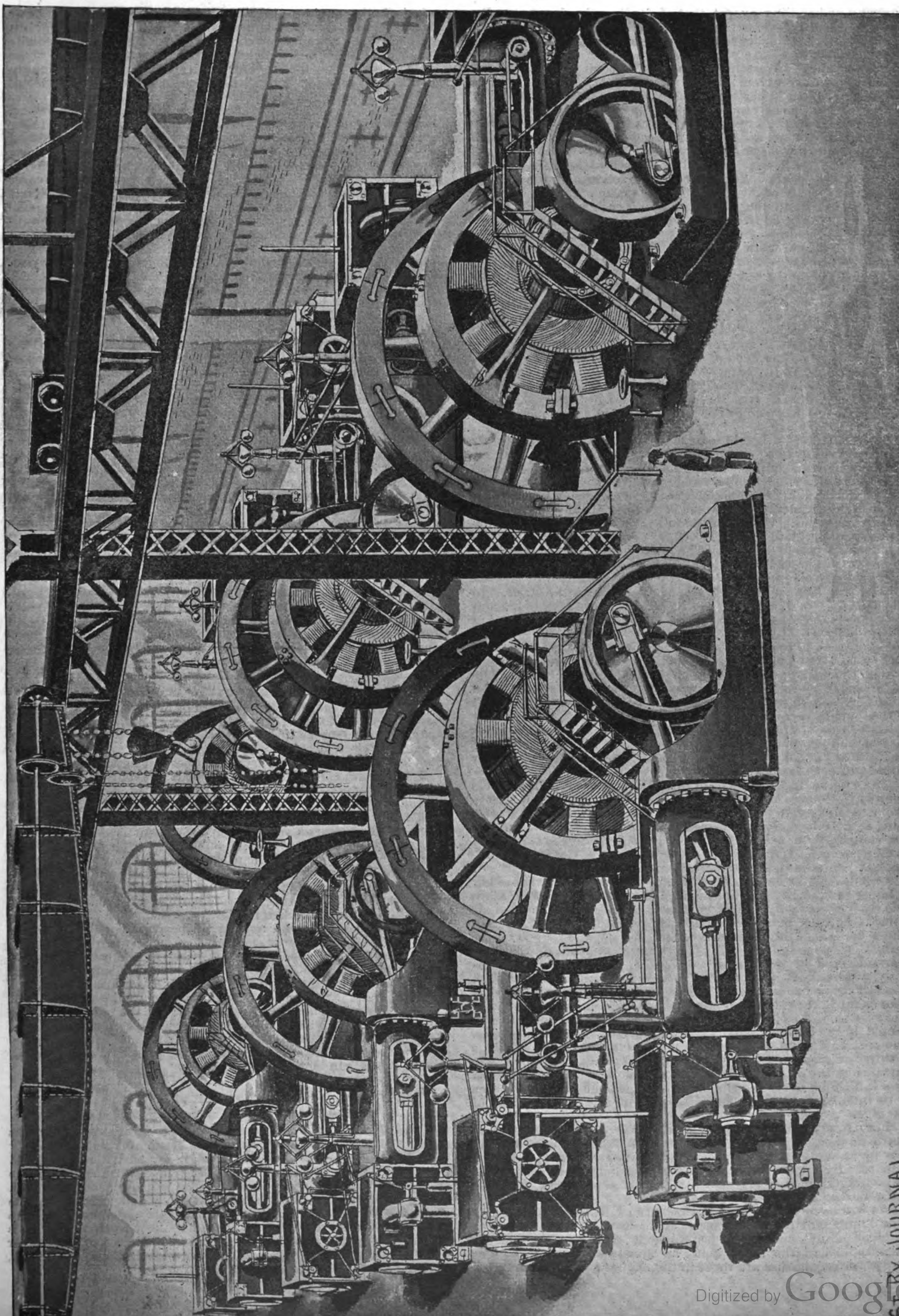


Fig. 2.—Engine and Dynamo Room, in the Eastern Power Station of the Brooklyn City Railway.

requiring no handling except that of feeding the furnaces. By means of special devices the coal will be weighed before leaving the chutes, so that an accurate record can be kept of the amount of coal consumed. By a similar system of ash chutes the ashes are carried to the basement of the building, whence they are removed by another system of Hunt conveyors.

The floor of the boiler room will, of course, be of concrete. A portion of the boiler room 36 × 28 ft. in greatest dimensions, is partitioned off for a pump room. This room contains two Worthington pumps for use in forcing the feedwater from the hot well through the manifolds and economizers. They can also pump the feedwater to the boilers, as will be described later, in case the regular feedwater pumps operated in connection with the engines should break down or fail to act for any reason. The smoke flues, which are two in number, are located on each side of the boiler house, and are 8 × 22 ft. and 9 × 21½ ft. maximum dimensions respectively, in cross section. These flues, lead from the boiler room to the second main division of the building containing the economizers and stack. A cross connection, 8 × 12 ft. in section, is provided before the economizers are reached, and another cross connection, 8 ft. 4½ ins. × 10 ft., is located beyond the economizers. Both of these are furnished with dampers, so that the gases from the furnaces can be made to pass through the economizers from one side or the other, as may be deemed desirable. The economizers are six in number, and are of the Green type, being furnished by the Fuel Economizer Company, of Matteawan, N. Y. A by-pass, 10 × 14 ft., is provided at each end of the row passing under the economizers. This by-pass is controlled by a swinging damper, so that it can be closed or opened at will. Each economizer opening can also be closed by a sliding damper, 9½ × 7½ ft.

The stack, has a height of 292 ft. 6 ins., from the top of its foundation to capstone. It rests on a granite base, 38 ft. 6 ins. square at the top, and 14 ft. deep, which rests on 9 ft. of concrete which in turn is supported on 1,200 piles. The stack contains over 2,000,000 bricks, and its total weight is said to be about 3,000 tons. The iron cap surmounting the stack weighs about 5 tons, and is 27 ft. in diameter. Up to the middle of the flue rises a baffle-plate of firebrick to a height of 60 ft. This is to give each of the two flues a separate draught. The main flue is 17 ft. in diameter. To increase its capacity a forced draught will be used. For this reason, two twelve foot Sturtevant fans, to be operated by electric motors, are located in the flues at the base of the stack. To celebrate the completion of the stack, a dinner, to which about sixty guests were invited, was given in its interior on the evening of November 25.

The system of live steam piping adopted is duplicate throughout. Two large mains, twenty inches at their point of largest diameter, dropping off to fourteen inches diameter extend the entire length of each boiler floor, and are connected to the steam drums on each boiler by headers eight inches in diameter. Each of these mains is connected with a separator, and from thence by means of four twenty inch pipes to four mains extending under the engine room floor. Valves are arranged so that any boiler can feed into any main, and any portion of the mains of any boiler can be put out of connection.

The engine room shown in Fig. 2 contains six E. P. Allis Company's cross compound engines with cylinders thirty-two and sixty-two inches diameter and sixty inches stroke, rated at 2,000 h. p. each, at most economical points of cut-off. Each engine will drive a 1,500 k. w., multipolar generator of the twelve pole type built by the General Electric Company. The engines can take steam from either main, can run condensing or non-condensing as may be desired, and are arranged so that either cylinder can be cut out, and the high pressure or the low pressure side can be used only. Each engine is provided with its own air pump, feedwater pump and circulating pump for condenser use. These are all of the Allis make, and are operated by six Allis vertical Corliss engines. The condensers used are of the type manufactured by the Wheeler Condensing & Engineering Company, of New York, and one condenser is installed for each engine. The salt water for condensing purposes is taken from the Wallabout channel, the circulating pipe being thirty-six inches in diameter reduced to a sixteen inch pipe for the last two engines, and connected to the different condensers by fourteen inch suction pipes. The outboard circulating water pipe for each side of the house is a thirty inch pipe, which joins into a thirty-six inch pipe. The entrance to the inboard pipe at each engine is, of course, protected by a fish trap and screen, the latter being so inclined that the area of its interstices is equivalent to the area of the cross section of the pipe.

For operating non-condensing each side of the engine room has a duplicate system of thirty-six inch exhaust pipes, making four pipes in all. Each duplicate set of pipes enters a forty-two inch stand pipe, with a Stein exhaust head eighty-four inches in diameter. Each engine is also fitted with a receiver, separator and reducing valve.

As will be seen, the greatest precautions have been taken to secure impossibility of the necessity of shutting down in case of accident to any portion of the equipment. This same system has been applied to the feedwater. As already mentioned, the feed pumps for regular use are those in the engine room, driven by the vertical Corliss engines operating also the circulating and air pumps, and in case of accident to these the Worthington pumps installed in the pump room can be put into service. To provide against the exceedingly remote contingency of both of these systems being unavailable, four Metropolitan injectors, manufactured by Hayden & Derby, have been installed with sufficient capacity to operate the entire plant.

To insure an ample supply of feed water under all conditions, a reservoir of large capacity will be constructed, probably under the pier. This will be kept constantly full, and can be relied upon for supplying feedwater for some days, if, for any reason, the city water service should be interrupted. To provide against the possibility of all of these sources of feedwater becoming unavailable, arrangements are made for the use of salt water in the boilers. Lubrication will be secured by a special system of piping from an oil reservoir, situated over the economizer room, to each of the bearings, whence the oil will pass to a filter and then be pumped to the reservoir. The engine room also contains two traveling cranes of thirty tons capacity each provided by the Boston Bridge Company.

If for any reason the engines should exceed their rated speed by more than 10 per cent., a special automatic stop valve will close and cut off the steam. This stop valve is automatically worked by a special governor.

The drip system in the engine room will be very complete, the water of condensation being returned to the boilers by means of automatic drip pumps. Water from the boiler house pipe drips will be returned to the boilers by the usual manner, gravitation.

The generators are similar to the one in operation at the World's Fair. The field of this generator, it will be remembered, is fifteen feet in diameter, and weighs considerably over 80,000 lbs., and the armature, wound on a cast iron spider, weighs over fifteen tons, and is keyed to the shaft of the engine. The commutator is seven feet six inches in diameter, and there are twelve sets of brushes. The shaft also carries a large flywheel, weighing about 150,000 lbs., and the whole is designed to revolve at a speed of seventy-five revolutions per minute.

The interior of the engine room will be very handsome. The walls will have a dado of enameled brick for a height of six feet, above which will be Philadelphia pressed brick. The switchboard will be of the panel type. Plenty of light will be afforded by the many windows and monitor roof during the day time, and at night many incandescent lamps will furnish the necessary illumination. All parts of the boiler house will be ventilated with exhaust fans. The main entrance to the power station will be on Division avenue, and in addition to the machinery already mentioned, the building will contain a store room, two general offices, an engineer's office and an elevator.

BRAKING AND TROLLEY ACCIDENTS.

In view of all that has been written of late concerning braking and street-car accidents there still seems to remain one thought needing to be emphasized. It is this:—Even with the present methods of electric street car control, accidents will be soon become less frequent than on horse-car lines during the past.

Many of the communications in both the daily and electrical papers lead one to infer that the present list of accidents is to continue indefinitely, unless the present methods of car control be radically improved. This is a mistake. The cause of nine-tenths of the accidents so common at present is due entirely to the forgetfulness of the general public that trolley cars run at a much higher rate of speed than the comparatively slow moving horse-cars. The utter nonchalance with which even ladies allow the noses of car horses to graze their shoulders, proves that the many years of slow moving transit has formed a habit much too strong to be entirely broken in a few months.

Rapid transit must be *rapid* and the public will learn, perforce, that more time allowance must be made when crossing the tracks ahead of the modern trolley car. In the very nature of things there must be a limit to the *practical* length of time required to bring a rapidly moving car to rest, and the comfort of the passengers, for whom the car is run must not be overlooked. The education of the public in this matter is the only solution to the problem of preventing street car accidents on trolley lines. The history of the past indicates that surface rapid transit in cities has come to stay, and in the future, the public will enjoy even greater speed than is now in vogue.

D. McFarlan Moore.

New York City.

RAILWAY EXTENSION IN PENNSYLVANIA.

The Manayunk Passenger Railway Company which has secured a charter for a trolley road in Manayunk will act jointly with the Wissahickon and Roxborough Inclined Plane Railroad Company. It is the intention of the two companies to use the trolley and build the roads as soon as the weather permits in 1894. A big network of trolley lines is contemplated, connecting the Roxborough line with the Norristown People's line, and making a continuous electrical road from Philadelphia to Norristown. It is estimated that the new road will cost from $25,000 to $30,000 per mile. The Roxborough line will be five and a half miles in length, with a two-mile branch to Manayunk.

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ELECTRICAL NAVIGATION.

THE closing of the Erie Canal for the winter has brought temporarily to an end the recently begun experiments to apply the electric motor for canal boat propulsion, and the authorities will now have to await the coming of spring to carry out to a more definite conclusion the work which we feel certain will find a permanent place among the applications of the electric current. In our previous comments on the subject under discussion it was pointed out that some of the methods employed in the late experimental trial could be looked upon only as temporary expedients, and in this view we are confirmed by the experiments since made and from information obtained from the promoters of the scheme. The abandonment of the trolley pole in favor of the overrunning trolley, similar to that used on the early Van Depoele roads, was a foregone conclusion; and the freedom of motion of the boat which it permitted, as described by Mr. John Dennis, Jr., on another page, gives ample proof of its adaptability to this purpose. As conjectured by us, the maturer plans of the promoters of the enterprise involve the application of high tension alternating current reduced to a safe working pressure at the trolley lines for alternating motors.

While there appears to be no insuperable objection standing in the way of a successful consummation of the plans as above outlined there are not a few who hold to the opinion that for this class of propulsion a "dead pull" is more economical of power than the propeller; that is to say, that a small locomotive or other traction device running on the bank and hauling the boat in the old fashioned way would answer all the requirements of actual practice. For those who incline to this view of the question the experiments made by Horatio Seymour will prove of value as affording an adequate idea of the pull required to propel canal boats, at the speeds indicated on another page of this issue. It would seem, however, that there is a wider aspect to the problem which is made much of in a recently published interview with Mr. Martin Schenck, New York State Engineer. Mr. Schenck inclines to the opinion that the electric canal boat can never be a success, at least on the Erie canal, because when it reaches the Hudson River it is as helpless as the horse boat. It seems to us that this argument against the use of the electric canal boat is about as valid as one which should impugn the usefulness of steam railroads because, perchance, they happen to end at points where passengers are obliged to continue their journey by stage coach or steamer. If a distance, of 350 miles out of a total of 470 can be accomplished in a fraction of the time now required to cover the distance it needs no great amount of calculation to determine the economy of the system. But looking further at this objection, is seems to rest on the assumption that by no possible means could an electric canal boat be operated on a river except by the use of storage batteries and that their employment for this purpose is out of the question. But is this a foregone conclusion? We think not; and though we have no working plan to suggest by which an electric boat could obtain current from the shore and which would fulfill all the other requirements of navigation, it does not appear to us that such a plan is impossible of discovery, and, indeed, we recommend its study to those who are now engaged in the work under consideration. The more one considers the work at hand, the more does the conviction grow that the electrical engineer and the inventor both have open to them a wide field in electrical navigation.

SAFETY ON THE TROLLEY ROADS.

THE Kings County (Brooklyn) Grand Jury has made a presentment with regard to trolley road operation, the main point of which is limiting speed to 8 miles an hour, anywhere. Such a low rate of speed is, of course, of little use for "rapid transit," in a great, sprawling city like Brooklyn, and the recommendation simply confirms the view already expressed in these columns that really high speed can only be enjoyed with elevated or underground roads. To adopt electricity as a means to rapid transit and then to keep down the speed, is absurd. A wise proposition made is that no one shall be employed as motorman who has not had at least one month's actual training.

It is worth pointing out that after all the newspapers' wild talk about the superlative danger of the trolley, the showing of the steam roads is much worse. Two wrongs don't make a right, but the figures from Boston are still an evidence that trolley passengers are tolerably safe. The Boston & Maine, Boston & Albany, Old Colony, New York and New England and Fitchburg railroads carried 91,077,130 passengers in the year ending June 30. The West End Street Railway carried 145,068,370 passengers, this including free transfers. On the five steam railroads 362 fatal injuries are reported, and on the West End 20. Of this number 45 of those killed on the steam railroads were passengers and on the West End one. Of those killed on the steam roads about 300 were employés. On the steam railroads 1,470 persons were injured and on the West End 310. On the steam railroads one person was killed or injured to every 23,225 miles run. On the West End one person was killed or injured to every 56,575 miles run upon the crowded public thoroughfares. Out of 145,068,370 passengers carried by the West End road only one was killed, and there was only one injured to every 858,392 carried.

MISCELLANEOUS.

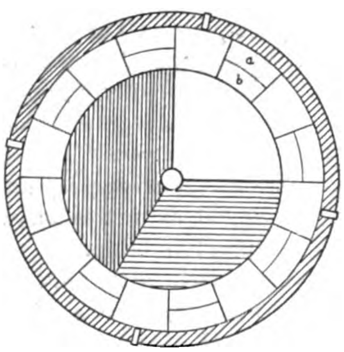
STUDIES OF THE PHENOMENA OF SIMULTANEOUS CONTRAST-COLOR; AND A PHOTOMETER FOR MEASURING THE INTENSITIES OF LIGHTS OF DIFFERENT COLORS.—V.—(*Concluded.*)

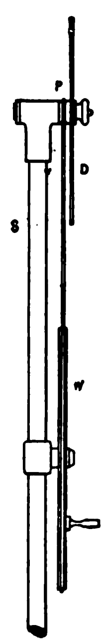
BY PROF. ALFRED M. MAYER.

The Rotating-Disc Photometer.—The photometer disc was taken apart and a ring of thin white linen paper[9] of the diameter of the disk and $\frac{2}{10}$ cm. wide was laid on one of the discs; this was covered by the circle of thin translucent white paper and on this was laid another ring of the thin linen paper. The other sectored disc of card-board was placed on these and the discs were now clamped together. The outer portions of the open sectors of the disc were thus closed by two thicknesses of the thin linen paper with the "alba tracing-paper" between them, *a*, in Fig. 17; while the inner portions of the sectors were closed by the tracing-paper alone, *b*, in Fig. 17.

On rotating the disc, it was not possible to balance the colors of the outer half (*a* in Fig. 17), of the ring formed of three thicknesses of paper, with the same central colored discs, used in the previous experiment, when one side of the disc was illuminated by lamplight, the other by daylight. But on increasing the saturation of the hues of the central discs and adding peripheral rings of the same hues, I succeeded in making the hues the same on both sides of the photometer ring. If equality of hue can be obtained when the photometer is illuminated on one side by lamplight and on the other by daylight, then the contrast-colors may be brought to the same hue when the photometer is illuminated on one side by a candle or petroleum flame and the other side by the electric arc light or by the whitest Welsbach incandescent lamp.

With a change of distance of the petroleum flame from the photometer the differences in the illumination of the portions *a* and *b*, Fig. 17, of the ring were changed. When the two sides of the ring were equally illuminated the rings *a* and *b* appeared indistinguishable, fusing into one ring of uniform tint and illumination, of the breadth of $a + b$.





FIGS. 17 AND 18.

With the best Bunsen photometer disc[10] I was unable to decide where it received equal illumination on its sides, so difficult was it to judge of equal brightness of the blue and orange on one side when compared with the orange and blue in the same respective positions on the other side of the disc.

With a petroleum flame of 40 candle light giving power on one side of the rotating photometer and a candle on the other, the delicacy of the indications of the rotating photometer equaled, and even slightly excelled, those of the very best Bunsen photometer disc.

If we bring in succession the translucent sectors of the rotating photometer disc between two lights we observe that, on certain sectors, *a* and *b* appear as one surface of the same uniform tint and illumination; on other sectors, sometimes *a*, sometimes *b*, is the brighter. Rotation of the disc entirely destroys such slight differences and the disc then acts as if made of absolutely homogeneous material, placed in the same conditions of contact of the layers of paper, in each translucent sector.

The hue of the light of "a white incandescent Welsbach lamp" compared with daylight.—When the screen, Fig. 1, is illuminated on one side by the Welsbach lamp and on the other by daylight, the side of the ring of the screen facing the daylight appears a feeble blue decidedly tinged with violet. The side of the ring facing the Welsbach lamp is colored greenish orange. This greenish orange was matched in hue, but not in luminosity, by a rotating disc having 41.5 parts of red lead, 41.5 of chrome yellow and 17 of emerald green, viewed illuminated by daylight. This appears to be the hue of the Welsbach light when compared with daylight.

Experiments in which are compared the hues of the light of an incandescent Welsbach lamp and of candle light.—When "a white-light incandescent Welsbach lamp" is placed on one side of the large screen, Fig. 1, and a candle, or petroleum flame, on the other side, the card-board ring of the screen facing the Welsbach light appears of a light bluish green; the side of the ring facing the candle, or petroleum flame, appears of a light carmine.

Matching these hues on the rotator with split discs gave the following results when the two sides of the screen were equally illuminated. The hue of the ring on the side facing the Welsbach lamp was matched by eight parts of emerald green, 10 of cobalt blue, 25 of ivory black and 57 parts of white Bristol board, as seen illuminated by the Welsbach lamp. The hue on the side of the ring facing the candle or petroleum flame was matched by 12 of carmine, 17 of ivory black and 71 of white cardboard, as seen illuminated by the petroleum flame.

Experiments with the rotating photometer-disc placed between the Welsbach lamp and the petroleum flame.—On rotating the photometer disc without any central discs, between these lights, the same hues as those already described were seen on its sides, only these hues were much less saturated.

The white discs placed on the sides of the rotating photometer made the hues less saturated

With a white disc on the petroleum flame side and a black disc on the Welsbach lamp side the difference between the hues of the sides of the photometer were more pronounced.

With a disc of cobalt blue, emerald green and white on the Welsbach-light side and a white disc on the petroleum flame side, the side of photometer facing the Welsbach lamp appeared white and the side facing the petroleum flame was less carmine; the differences in hue being less than in any of the previous experiments.

By trial I found that when a disc of 33 parts of emerald green, 42 of cobalt blue and 25 of white was placed on the Welsbach lamp side of the photometer disc with a ring of the same hue on the periphery and a disc of 75 parts of carmine and 25 of white was on the petroleum flame side of the photometer disc, with a ring of the same hue on the periphery of the photometer, that the sides of the photometric ring of the photometer had the same hue; which was white tinged with just a perceptible carmine.

We are now in condition to make an interesting experiment which shows in a striking manner the effects of the colored central discs and peripheral rings on the colors of the photometric ring of the photometer. The exact balance of hue on both sides of the photometer has been obtained. Reverse the photometer disc with its central disc and rings and rotate the disc in front of the mirrors. We now see the photometric ring with strong contrast of color on its sides, and the concentric rings *a* and *b* are separately seen, not appearing indistinguishable as in the previous experiment. By the reversal we have by the effects of the colored discs and rings added to the effects produced alone by the lights.

It is to be noted that the colors on the disc and rings of the photometer must not be too saturated in hue. The elementary discs of these compound color discs should be made of thin Bristol board and after they have been painted should be well flattened before they are slit radially. After the proper hues have been obtained for the discs which correct the color of the photometeric ring, the same hues should be painted on single discs, which are subsequently flattened. The thinner the color correcting discs and the closer they fit to the photometer disc the greater is their contrast-color effect. The colored rings must be cut out of the painted card-board, for if the rings are painted after they are formed it is very difficult to make them flat.

To render easy the making of this photometer I made experiments so that one could get the proper hues of the correcting discs and rings by mixtures of definite weights of the pigment powders and definite volumes of gum water; but it is less troublesome to paint a few discs with colors variously saturated and repeat the experiments I have described, and thus furnish oneself with the sets of discs and rings necessary for the photometric measures of the arc electric light, of the Welsbach white burner, etc., when compared with the standard candle or petroleum flame.

The rotator on which the photometer disc is revolved should be made as shown in Fig. 18, so that the standard S, and the pulley P, which is driven by the wheel W, shade as little as possible the rotating disc D.

Photometric measures with the Rotating-Disc Photometer.—On one side of the photometer was placed "a white Welsbach burner" with a light-giving power of 33 candles, on the other side a standard candle. As the candle was gradually brought

9. The best paper I have experimented with for this purpose is water-marked "Crane & Co., Dalton, Mass., Bond, No. 21."

10. The best Bunsen photometer discs I have used are those sold by the American Meter Company of New York. They are made in England.

nearer the rotating photometer the illumination and hues of the portions of a and b (Fig. 17), of the photometric ring approached equality and when the candle was at a certain distance the difference of illumination and hues of a and b became indistinguishable and only a band with a breadth of $a + b$ with a uniform surface was observed on the sides of the photometric ring.

The measures of the intensity of the light of the Welsbach lamp in terms of the standard candle were made by a friend. He made 16 measures with my rotating disc photometer and 16 with the Bunsen photometer.

The mean of the series of measures made with the Rotating-Disc Photometer differed from the mean of the departure of the maximum and minimum measures from the mean by 1.49 per cent. of the mean intensity of the light of the Welsbach lamp.

The mean of the series of measures made with the Bunsen Photometer differed from the mean of the departure of the maximum and minimum measures from the mean by 5.22 per cent. of the mean intensity of the light of the Welsbach lamp.

THE CALIFORNIA MIDWINTER EXPOSITION.

Mr. W. F. Hasson, secretary of the California Midwinter Exposition, writes us that the Fair is rapidly assuming shape and that all departments are working night and day to produce a creditable result when opening day comes.

Director-General De Young has closed a contract with the Western Electric Company for lighting the central tower. This will be 266 feet high and will have a standing outline illumination of 2,000 incandescent lamps. In addition to this there will be twelve changing pieces of different lights and as the Exposition progresses, these designs will be varied from time to time. On top of the central tower will be placed the large search light of the General Electric Company.

It is proposed that the tower shall stand as near the centre of the Concert Valley as possible, so that all sides will receive an equal share of light. While the prime object of the tower will be for lighting purposes, it will also be used as a grand band stand in which music will be played throughout the day and evening. It will be supplied with an elevator which will run up the height of 220 feet and pavilions on the ground floor open to the public. Four Moorish pavilions sixty feet high will flank the open spaces, each of which will contain four stories, all gorgeously decorated in oriental colors. The second floor of the tower or first gallery eighty feet from the ground will be divided into four chambers, two for the bands and two for seats for the visitors. This gallery will be thirty feet square and will have a seating capacity of 200. Three other galleries will extend beyond this one.

The second floor will be 140 feet high and will afford room for 150 people and the third, 210 feet standing room for 100. The topmost gallery will extend up within six feet of the pinnacle or 260 feet. It will be the only one of the galleries not open to the public. It will be utilized however, for the purpose of showing the wonders of the searchlight, two of which will be there mounted. On the extreme top of the tower will rest an enormous gold ball bearing the emblem of the State, a massive California bear.

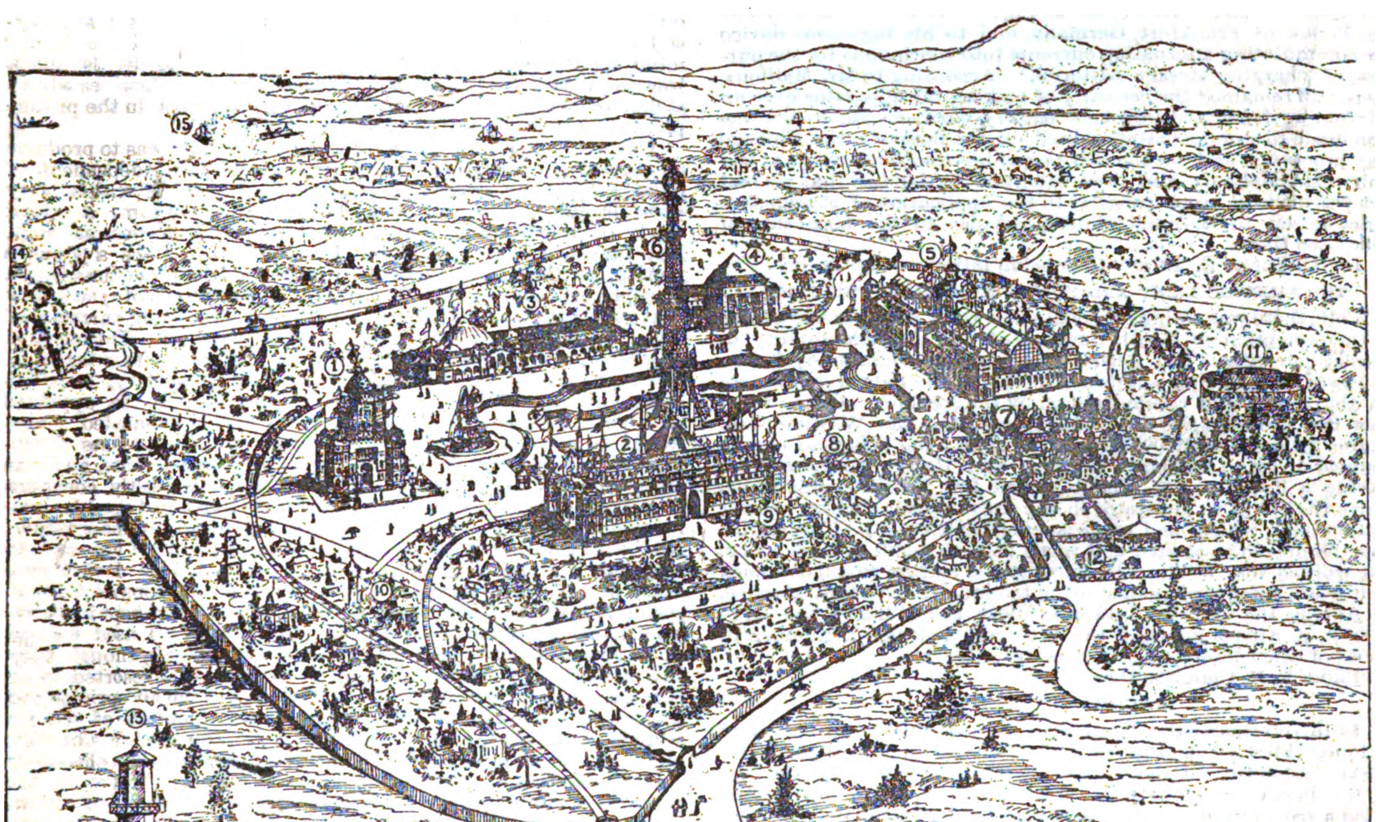
Ample accommodations will be made for the seating of 3,000 people in the tower at one time, while on the outer edge of the circular walk there will be room for several thousand more spectators. The lower part of the tower has been designed with a view of producing striking effects. The pavilions which form the foundation of the tower are in a sort of basin, serving admirably as an amphitheatre and at each of the four corners is a cascade with cafés on each of the sides. There are eight approaches to the centre of the tower, practically making it open on all sides and corners.

The General Electric Company will also furnish one of the World's Fair fountains. Lack of time has prevented the developing of an individual fountain, but the setting will be so different and so much more advantageous that the few necessary changes will, it is said, render the fountain unrecognizable.

The exhibits will be largely working ones; the Fort Wayne Co. have entered arc machines which will illuminate the Central Plaza; the Western Electric machines will illuminate the Manufactures' Building; the Standard Electric Co. will have an exhibit to illuminate the Agricultural Building and a portion of the grounds, and the General Electric Co. will furnish a direct current system for the exterior decorative lighting of the main buildings. Present arrangements provide for 1.000 arc lights and 15,000 incandescent lights independent of the special features.

The work for concessions is becoming more extensive every day, and it is difficult to tell at what point it will stop.

Passed Assistant Engineer A. M. Hunt, U. S. Navy, has been granted leave of absence by the Navy Department and has been appointed superintendent of the Department of Machinery. The department of Mechanical and Electrical Engineering is now in full working order. The scope of the California Exposition is much broader than is generally understood. It reaches to Mexico, Central America, the Western Coast of South America, Hawaii, New Zealand and Australia.



1. Agricultural Building. 2. Mechanical Arts Building. 3. Horticultural Building. 4. Fine Arts Building. 5. Manufactures and Liberal Arts Building. 6. Electric Tower. 7. Vienna Prater. 8. Hawaiian Exhibit. 9. Chinese Exhibit. 10. Oriental Concessions. 11. Aviary. 12. Buffalo Paddock 13. Water Tower. 14. Strawberry Hill. 15. Golden Gate.

Bird's Eye View of the Grounds.

SOCIETY AND CLUB NOTES.

THE NEW YORK ELECTRICAL SOCIETY'S WORLD'S FAIR SYMPOSIUM.—I.

ON Wednesday Nov. 29 the New York Electrical Society meeting at Columbia College, held a "symposium," the subject being "Electricity at the World's Fair." Brief addresses had been announced by a number of gentlemen, but lack of time necessitated the postponement of some of them until the next meeting of the Society. Interest in the subject was shown by the fact that the room was filled to overflowing.

The meeting was presided over by the vice-president, MR. C. O. MAILLOUX who introduced the speakers in a very happy style, and who himself opened the evening's discourses by giving an account of the

STORAGE BATTERIES AT THE FAIR.

The only interesting feature involving storage batteries at the World's Fair, said Mr. Mailloux, were the electric launches, and these involved more attention to detail than a high order of engineering. The exhibits of various types of batteries was very meagre, including only three foreign exhibits. Among these the portable battery of Wladimiroff[1] exhibited in the Russian section of Machinery Hall, presented some interesting features. Some three or four American batteries were exhibited with which most of us were familiar. The speaker also referred to the storage batteries exhibited by Mr. Ch. Pollak of Frankfort, Germany, and to his ingenious device for commutating alternating currents into continuous for the purpose of charging storage batteries.[2] According to Mr. Mailloux there still remained the necessity of making the apparatus give an alternating from a continuous battery current. Reference was also made to storage batteries used on the floats in the Chicago Day procession and on the self-propelling electric carriage at the Fair. Mr. Mailloux also drew attention to the fact that we had not yet made as much progress in the application of storage batteries as was to be found abroad, and also to the large sizes of cells used there.

DR. CHARLES E. EMERY then being introduced spoke on

THE ELECTRIC LIGHT AND POWER ENGINES AT THE FAIR.

While there was nothing specially new there, progress was shown in the perfection of detail, increase of size and adaptability to special purposes. The Corliss type was shown in many forms. Views of the principal engines exhibited at the Fair were thrown on the screen and commented on by the speaker. Among them was the Edison 2,800 kilowatt generator; the Westinghouse engine driving the 10,000-light alternators; the Schichau engine coupled direct to the large Siemens and Halske generator and having a Ryder valve. The Lake Erie Iron Works engine which drove the 750 k. w. generator in the Intramural Railway power station and which had made a remarkable record. This engine was the first to be started and was a little to small for its work, but worked very well and he thought this feature would be copied as it was a safeguard against using too much current all at once.

Among the other engines shown was the Willans[3], the large 2,000 h. p. Allis engine and the Williams and also a number of views of other interesting mechanical subjects.

PROF. F. B. CROCKER then spoke on

ELECTRIC CONGRESSES.

In three respects the Electrical Congress at Chicago had been unique. First, it had given final values and names to electrical units; secondly, it had given official sanction to the use of the henry, in honor of an American, and which thus constituted a recognition of America in electrical science; and third, on account of the importance of the papers read and the eminence of the men who read them. The presence of most of the prominent electricians at Chicago, must also be considered an extraordinary result. The speaker thought that the somewhat lax business management apparent at the Congress was an insignificant matter, and did not in any way interfere with its success. PROF. CROCKER did not agree with Prof. Rowland in the view that there never would be occasion to hold another electrical congress, and he suggested as work for a future congress the fixing of magnetic units and names for them, a standard of light, and an international nomenclature for electrical terms and quantities.

MR. NIKOLA TESLA, then being introduced, spoke, as follows on his

ELECTRICAL OSCILLATOR.

You may perhaps know, at least those of you who have followed the electrical development more closely, that the subject about which I am to say something is one which I recently presented before the Electrical Congress. During the past two years or so I have been gathering results and preparing a work which I had the intention to present before the last annual meeting of the American Institute as one of its members. Now, as a matter of fact, at that time I had gone considerably into the study of the practical aspects of the work which I was completing and my notion was that I was touching upon something very important, which would lay the foundations of a novel industry, perhaps of more than one industry. But to speak in that strain before such a gathering as I had the honor to address at the Chicago Congress would have required a nerve which I did not possess; or if I did possess it, it would be sure to leave me when I wanted to use it; and so I dwelt chiefly on those features which possessed a purely scientific interest, my desire being to present the subject very modestly, as I was not quite sure of the practical side of some of the questions involved. Right after the lecture I asked one of my friends what he thought of it. He said it was good enough but it could have been better. A prominent engineer came to me and said "Mr. Tesla, I want to tell you something but I fear it may offend you." I knew what was coming and so I asked what it was. He said "Well, don't you work on steam engines. You have done some work in electricity. If you stick to it you will do some good work, but if you work on steam engines you are bound to fail." (Laughter.) All these men that I mention are some of the most prominent men in the profession. Another said, "I wonder what Tesla is going to do with his blessed engine." Another, to whom I showed the advantage of doing away with complicated mechanism and generating electricity directly, said, after he had watched for a long time an apparatus running some incandescent lamps, "Couldn't you apply this to *rotating* motion?" Now this is the way in which my work was received. (Laughter.) But I was quite prepared for that because for fully two years I had myself rejected these ideas again and again, though I had in my mind the construction of the apparatus in many details; but it was not until I overcame experimentally some difficulties which at first seemed to me insuperable that I gained faith in the principle, that I finally resolved myself to this work.

One of the first impulses which have guided me was to produce an absolutely constant oscillation which would be independent of friction losses, or gravity, or temperature changes within very wide limits. Now, we can employ a pendulum, a clock work or a vibrating spring, or some such device as that. But they are very unreliable. I wanted to produce a positive motion, so that I might operate what I called some time ago a disruptive discharge coil. I may assume that some of you know that some time ago I advanced a method of producing currents of high frequency from direct or alternating currents. The method consists in charging condensers, discharging them either through a primary and then inducing in coils of the secondary, or in its own, currents of high potential. The lamp to be operated with such coils is already perfected. A nearly exhausted vessel would be good enough for the purpose. But the devices themselves are inefficient in the production of these currents, and one reason is that these devices do not yield a perfectly constant vibration. I had to depend on a disruptive gap and I used in connection an air blast or oil stream or a mechanical interrupter. Now with this device which I invented subsequently I was able to maintain a vibration with perfect constancy. This device consisted of a powerful spring which required several tons of force to spring it a certain distance and which was constantly kept in vibration by steam or air pressure. In the beginning I used springs of tempered steel. These steel springs would break, though they had a section of two or three square inches. So I resorted to air springs. The air springs would not break, but the air springs had no constant resilience. Then I made the chambers of the air springs communicate with the outer air. This gives a vibration constant enough, but the temperature of the air in the chambers can be maintained quite constant as by boiling water in the jacket surrounding them. The device yields a constant vibration, and as the force which is driving it is many tons and the friction but a very small matter, it is unaffected by the variations of the steam or air pressure. This was one of the chief features I wanted to present.

1. See THE ELECTRICAL ENGINEER, Sept. 27, 1893.
2. See THE ELECTRICAL ENGINEER, Sept. 13, 1893.
3. See THE ELECTRICAL ENGINEER Oct. 25, 1893.

THE FRANKLIN INSTITUTE.

THE *Journal* of the Franklin Institute for December, contains a transcript of the Paper entitled "Charles A. Coulomb," read by Prof. E. J. Houston, before the Institute on March 28 last, headed by an excellent portrait of Coulomb himself. The paper, it will be remembered, is based on a eulogy of the eminent scientist by Délambre and deals with his life and works in chronological order.

On October 24, Mr. Carl Hering read a Paper entitled "Notes on Recent Developments in Electricity Abroad" consisting of a *résumé* of recent articles appearing in the foreign electrical journals.

The lectures thus far announced for the remaining meetings of the season of 1893–4 are as follows: "Thoughts on Cosmical Electricity," by Prof. Elihu Thomson, December 19; "The Theory and Design of the Closed Coil Constant Current Arc Dynamo," by Prof. H. S. Carhart, December 26; "Telephony," by Mr. J. J. Carty, February 27; "Magnetic and Dielectric Viscosity," by Prof. M. I. Pupin, April 24; and a lecture by Dr. Wm. J. Morton, on some branch of electro-therapeutics, the title of which has not yet been announced, on June 26.

INSTITUTE BADGE JEWELRY.

The Committee upon Badge and Certificate of the American Institute of Electrical Engineers has completed its labors which resulted in the adoption by the Institute of a standard pin or badge which has already been described in these columns, and to meet with demands of certain of the members the badge has been made up in a number of useful and artistic forms, which can be secured upon application to the Secretary, Ralph W. Pope, 12 West 31st St., New York.

The exposed portions of these articles are made of 18 karat gold with backing of 14 karat gold and are of the same general character as the badge, of which a large number have already been issued to members. The price of the pin, lapel button, scarf pin and watch charm is the same, namely, $3; that of the single locket $8 and of the double locket $10.

The certificate of the Institute which was adopted at about the same time as the badge, is now being issued. It is a handsome steel engraving, and all active or full members are entitled to receive the same upon application to the Secretary, and upon payment of $2, to cover cost of printing and engraving.

Personal.

CAPTAIN JOHN MILLIS, U. S. A.

The marriage took place on Nov. 22, at Atlanta, Ga., of Capt. John Millis, Corps of Engineers, U. S. A., to Miss Mary Raoul, daughter of Mr. and Mrs. W. G. Raoul of that city. Capt. Millis and his wife will take up their residence in New Orleans, where he is now stationed, after January 15.

Mr. Hugh T. Wreaks, M. E., has opened on office at 1,217 Filbert street, Philadelphia, as consulting and supervising electrical engineer. Mr. Wreaks has had considerable experience of late years with the Westinghouse Company in connection with their railway work, and has gained the confidence and friendship of a wide circle of electrical men who will wish him deserved success in his new field.

Mr. G. H. Almon, E. E., formerly on the staff of the General Electric Company, has opened an office at 136 Liberty street, New York, as an electrical contracting engineer, and also as sales agent for some well-known electrical appliances.

Obituary.

J. J. KIERNAN.

We regret to announce the death of ex-state senator J. J. Kiernan, of pneumonia, in Brooklyn, at 49 years of age. He began business life as a clerk with the Western Union Telegraph Company, when he began the collection of financial and Wall street news. This branch of work he afterwards made a specialty of very successfully, and Kiernan's News Agency has long been one of the leading elements in downtown life. He also took an active part in commercial and political affairs. One of his sons, Frank J. Kiernan, is manager of the Foreign and Domestic News Company.

MR. S. WILCOX.

We regret to announce the death of Mr. S. Wilcox, vice-president of the Babcock & Wilcox Co., builders of the celebrated boilers bearing that name. The funeral took place last Wednesday. Mr. Wilcox was a man of very retiring disposition, whose high ability and many sterling qualities were but little known outside the circle of his intimate friends.

Legal Notes.

INCANDESCENT LAMP LITIGATION—EDISON ELEC. LT. CO. vs. DAVIS ELEC. WORKS.

Judge Colt of the United States Circuit Court in Boston last week listened to a motion for an injunction made by the Edison Electric Light Company against the Davis Electrical Works. The Edison people claim that the Davis establishment, has been infringing the Edison incandescent lamp patents. Judge Colt reserved his decision. The local establishment employ about 60 men, and devote their attention to repairing old incandescent lamps of all makes, and this is the ground of the action. The old filaments are taken out and replaced with new ones, and the Davis Company have built up a big business of this sort. The Davis Company have engaged John L. S. Roberts of Boston as counsel.

THE WESTON HYDRO-CARBON PATENT DECLARED INVALID.

By a decision handed down on Dec. 2 by Judge Dallas of the United States Circuit Court of Appeals for the third circuit, the Weston patent on the hydro-carbon treatment or "flashing" of incandescent lamp filaments, owned by the United States Electric Lighting Company—who are the lessees of the Westinghouse Company—is declared invalid. The decision upholds the finding of the lower court, and is a final victory for the Edison Lamp Company, against which the suit was brought.

The ground of the decision was that Weston was not the first inventor of the subject matter patented, and that the patented process had been in public use more than two years previous to his application for his patent. The right of the Edison Company, therefore, to the employment of this treatment in the manufacture of incandescent lamps is affirmed. The case was argued by Mr. G. H. Christie for the appellants and by Mr. F. H. Betts for the defendants.

Letters to the Editor.

CRITICISMS ON BENJAMIN'S "THE VOLTAIC CELL."

Sundry thoughtful and friendly souls have of late called to my notice a criticism of my "Voltaic Cell" which appeared in the Cornell University *Physical Review*, which purports to have been written by Professor H. S. Carhart. They have expressed dissatisfaction thereat, and have volunteered replies, which however seem to me needless. If the effusion has any blemish it is that it omits to mention, perhaps inadvertently, the fact that immediately after the appearance of the book, this same critic wrote to me complaining that I had not done him "justice" therein in the description of a Clark standard cell, one form of which he is commercially promoting, and which also bears his name. He also disapproved of my statements relative to the very novel and original standard cell of Mr. Edward Weston and with which he competes. As to the good faith with the public, of such a person subsequently attitudinizing in the premises as an impartial judge, and whether the editors,—who could easily have discovered his interest, even if they did not know it, and who invited or allowed him so to appear,—have not somewhat erred in judgment, others may determine.

As to the obvious self-advertisement sought in this "review" through invidious reflection on myself I have only to remark that I remember reading—years ago and somewhere in Mayne Reid, I think—the story of an African explorer who once, while tramping through a half-cleared path trod upon what, if he had seen it, he might well have supposed to be a stray branch or stick. But this stick proved to be the permanent appendage of a very lively animal, which by leaps and bounds made its way to the top of a lofty palm tree, where, while pelting the explorer with cocoanuts with one hand, with the other and to the accompaniment of agonizing yells, it held up its lacerated member to the sympathetic observation of a shuddering universe. That's all there is of the story. It does not record that the hapless trespasser either hurled back the cocoanuts, or climbed the tree to apply salve.

Park Benjamin.

New York, Nov. 28, 1893.

THE DYING OUT OF ALTERNATING CURRENT WAVES.

It is well known that the shape of the alternating current wave given out by the secondary of an induction coil or converter is somewhat different from that of the alternating current fed to the primary, being somewhat flattened out, due to the magnetic lag in the iron. Can any of your readers inform me as to how many times an alternating current could be passed through successive induction coils or transformers without losing its essential character; in other words, when would it become so flattened out as to bear no further resemblance to the original shape of the wave? The bearing of this point on the proposed use of self-induction devices in submarine telegraphy and telegraph work generally is apparent.

G.

New York City.

REDUCTION IN THE PRICE OF EDISON LAMPS.

The General Electric Co. are, we understand, making an important reduction in the price of incandescent lamps. If we are correctly advised the price will be about 32 cents in lots of 1,000, and in quantities above that a further reduction will be made.

Mr. F. A. Scheffler, general sales agent of the Stirling Co., informs us that the company has sold the entire 2,800 h. p. of boilers exhibited at the World's Fair.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 21, 1893.

Accumulators:—

Storage Battery, E. P. Usher, Grafton, Mass., 509,266. Filed Jan. 23, 1893.
Relates to means for securing a perfect connection between the plates and the transverse bar uniting them.

Storage Battery, E. P. Usher, Grafton, Mass., 509,267. Filed Jan. 23, 1893.
Consists in a skeleton for battery plates having a conducting strip of aluminum in contact with the active material.

Storage Battery, E. P. Usher, Grafton, Mass., 509,268. Filed Jan. 23, 1893.
Relates to a mechanical construction of the metallic frames for the battery plates and to the porous separators holding the active material in the frame.

Storage Battery, E. P. Usher, Grafton, Mass., 509,269. Filed Jan. 23, 1893.
Employs a hollow flattened shell of metallic lead perforated on the sides with outwardly projecting burrs at each perforation and a filling of active material enclosed within the shells.

Storage Battery, E. P. Usher, Grafton, Mass., 509,270. Filed Jan. 23, 1893.
Employs plates formed of corrugated conducting metallic side walls finely perforated with a filling of active material.

Storage Battery, E. P. Usher, Grafton, Mass., 509,271. Filed Jan. 23, 1893.
Claim 3 follows:—
In a storage battery, lead plates, porous separators, end spacers to hold said parts in place, packed active material in the inclosed spaces, and outside pieces applied laterally to the outermost plates.

Storage Battery, E. P. Usher, Grafton, Mass., 509,272. Filed Jan. 23, 1893.
Employs an open shaft one side of which consists of the separator, one side of the metallic plate and two sides of closely packed active material.

Alarms and Signals:—

Electric Bell, W. J. Schweiger, New York, 509,050. Filed March 15, 1893.

Electro-Mechanical Slot Mechanism for Railway Signals, T. H. Patenall, Rahway, N. J., 509,098. Filed Jan. 6, 1893.
Relates to a device in railway signals in which the signal when mechanical set to "safety" may be set to "danger" by the manipulation of an electric circuit.

Block Signal Apparatus, A. H. Johnson and T. H. Patenall, Rahway, N. J. 509,127. Filed March 30, 1892.
An electric block system for steam railways.

Electric Signal Receiver, W. H. Kirnan, Bayonne, N. J., 509,171. Filed April 17, 1893.
Relates to means for preventing the time printing mechanism of a signal system from operating except when a message has been recorded.

Railway Train Order and Signaling Device, L. T. Crabtree, New London, Wis., 509,201. Filed June 24, 1893.

Fire Alarm Telegraph Repeater, T. F. Gaynor, Louisville, Ky., 509,216. Filed March 2, 1891.
Relates to an automatic fire alarm system in which an alarm given at one signal box is automatically repeated over all the other circuits of the system.

Combined Electric Time Stamp and Signal Device, T. F. Gaynor, Louisville, Ky., 509,217. Filed March 7, 1891.

Electric Signal Device, T. F. Gaynor, Louisville, Ky., 509,218. Filed March 16, 1891.
Relates to signal apparatus for municipal telegraphic service.

Non-Interference Signal Box Mechanism for Fire Alarm Telegraphs, T. F. Gaynor, Louisville, Ky., 509,219. Filed March 19, 1891.

Electrical Apparatus for Controlling Signal or other Circuits, H. A. Parrish, Jackson, Mich., 509,244. Filed Jan. 28, 1893.
Provides two independent but co-acting electric circuits including a bell, and a circuit controller common to both circuits to provide against the possibility of one circuit failing to act.

Lamps and Appurtenances:—

Casing for Electric Arc Lamps, P. Federmann, Berlin, Germany, 509,236. Filed Feb. 23, 1893.

Electric Arc Lamp, H. P. Ball, Brooklyn, N. Y., 509,014. Filed March 2, 1891.
Relates to apparatus for controlling the arc and to a cut-out for short circuiting the lamp.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 509,167. Filed June 29, 1893.
Consists especially of a lamp post carrying a laterally projecting arm to the outer end of which the carbon holders and feeding devices are alone supported while the heavy regulating devices are sustained close to the vertical part of the post.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 509,168. Filed June 29, 1893.
Has for its object a construction of lamp and post condensed into the smallest possible space.

Electric Arc Lamp, B. B. Ward, New York, 509,188. Filed Feb. 15, 1893.
Employs a derived circuit feed magnet coil, an artificial protecting resistance to assist in starting the lamp but normally out of circuit with said coil, and means for throwing the resistance coil into the circuit when the arc becomes too long or the lamp goes out of action.

Socket for Electric Lamps, W. C. Bryant, Bridgeport, Conn., 509,297. Filed March 22, 1893.
A socket for use with incandescent lamps having threaded bases and so arranged as to securely hold the lamp without the necessity of threading the socket.

Measurement:—

Electric Meter, J. Perry, London, Eng., 509,095. Filed March 28, 1893.
Employs a rotary shaft carrying at one end an armature entirely immersed in mercury and at the other end making contact through mercury in combination with an electric circuit the terminals of which are respectively in said bodies of mercury.

Amperemeter or Voltmeter, C. Wilkens, Frankfort-on-the-Main, Germany, 509,342. Filed July 19, 1893.
Employs an eccentric ring between two solenoids so arranged that the turning of the ring on its axis moves it parallel to the axis of the solenoids.

Miscellaneous:—

Electric Cigar Lighter, C. J. Jenne and C. E. Willey, Louisville, Ky., 509,-085. Filed Apr. 5, 1893.

Magazine Gun and Electrical Device Therefor, J. L. McCullough, Brooklyn, N. Y., 509,091. Filed Dec. 12, 1892.
Relates to mechanism for loading and firing.

Electrically-Controlled Door, F. Callahan, Bridgeport, Conn, 509,115. Filed April 8, 1892.

Coin Controlled Vending Machine, G. Richmond, New York, 509,181. Filed July 10, 1893.

Railways and Appliances:—

Automatic Railway Electric Signal, B. A. Karr and C. H. Bradrick, Omaha, Neb., 509,946. Filed Dec. 27, 1892.
An electric block system for steam railways.

Electric Railway, J. H. Vail, New York, 509,002. Filed Mch. 17, 1893.
Employs a number of separate conductors extending from one terminal source insulated from the earth and each having a predetermined fall of potential, each connected with the working conductor in connection with the earth at a predetermined point.

Electric Railway Conduit, G. T. Woods, New York, 509,065. Filed Oct. 14, 1892.
Employs a series of boxes having interior contact devices connected with the main circuit, each box charged with insulating fluid and having a porous medium through which the insulating fluid may exude and a switch arm controlling the enclosed main circuit contacts and operated by a contact brush carried by the car.

Electric Railway, J. H. Dale, New York, 509,072. Filed Mch. 1, 1893.
Relates to closed contact boxes located at intervals in a conduit in which a shoe or brush carried by the car acts upon the switch or contact during the passage of the car.

Trolley Mechanism, J. T Fuller, Calvert, Texas, 509,123. Filed July 17, 1893.
Employs a pivoted yoke for the trolley arm provided with wings adapted to limit the lateral movement of the yoke.

Electric Locomotive, J. C. Henry, New York, 509,311. Filed Dec. 15, 1891.
Relates to the construction of the truck and the method of supporting the motor.

Supply System for Electric Railways, J. C. Henry, New York, N. Y., 509,-312. Filed Aug. 20, 1889.
Employs a track of insulated sections, continuous line conductors having branches including the primaries of converters, and local circuits from the track section including the secondaries of the converters and adapted to be completed upon the passage of the car.

Hanger for Trolley Wires, G. H. Ricke, Cincinnati, O., 509,328. Filed Aug. 7, 1893.
Consists of two plates connected at their upper edge and each terminating in a jaw; the two held together by a pair of bifurcated clamps.

Switches and Cut-Outs:—

Automatic Thermal Cut-Out for Incandescent Electric Lamps, E. H. Johnson, New York, N. Y., 509,086. Filed April 3, 1886.
Employs leading-in wires bridged by a mixture of conducting material and a non-conducting gum.

Thermostat, H. S. Tunnard, Rugby, Eng., and A. M. Keays, Sutton, Eng., 509,056. Filed March 27, 1893.

Regulating Switch for Electric Elevators, H. A. Allen, Chicago, Ill., 509,279. Filed Feb. 20, 1892.

Current Controlling Device, W. H. Morgan, Alliance, O., 509,333. Filed July 22, 1891.
A rheostat and reversing switch especially adapted to traveling cranes.

Telegraph:—

Telegraphy, J. P. Wooten, Bainbridge, Ga., 509,066. Filed Nov. 18, 1892.
A system of machine telegraphy in which the message is received by apparatus resembling the ordinary typewriter in its general mechanism.

Signal Telegraph, C. V. Boughton, Buffalo, N. Y., 509,290. Filed Nov. 26, 1892.
Relates especially to the formation, arrangement and operation of the keys upon the board.

Telephones and Apparatus:—

Speaking Attachment for Telephones, W. and G. Weber, Philadelphia, Pa., 509,061. Filed Sept. 16, 1893.

Telephone Exchange Apparatus, C. E. Scribner, Chicago, Ill., 509,186. Filed Feb. 21, 1893.
The invention consists in a clearing out annunciator responding to pulsating currents and continuous currents but not to alternating currents and included between a pair of telephone lines at the central office.

LITERATURE.

Portative Electricity. By J. T. Niblett. London, *Biggs & Co.*, 1893. 234 pages, 5 x 7 inches. Price $1.00.

THE uses to which portable batteries can be applied are apt to be lost sight of in these days when current is on tap in even the smallest centres of population; but the large field which is still open to them and which can alone be adequately filled by them is prominently brought out by the work before us. This is divided into three parts; the first of these treats specifically of the uses to which portable stored electricity can be applied in mining operations to supplant oil lamps, and in instruments for detecting fire damp as well as in safety electric hand lamps for domestic purposes, meter inspectors and firemen. The author then describes their use and the fittings employed for the purpose in domestic appliances, such as reading lamps, the driving of motors and the sterilizing of water in domestic filters. Then follow the various applications of the battery current for medical purposes, astronomical, microscopical and photographic work; their use in the army and navy for search light and signaling purposes, for the lighting of railway cars and vehicles generally, also for electric navigation, and finally the many places in which they can be employed for decorative, stage and other effects.

The many applications made clear, the author next takes up and describes the various types of storage batteries now manufactured and then proceeds to give very complete instructions for the charging of portable accumulators and their methods of management. He has also added a short account of the principal thermopiles and primary batteries which may be occasionally brought into requisition where a portable source of current is required. The little work will prove of much interest to the amateur as well as to the electrical engineer.

A NEW YORK WEST SIDE ELECTRIC ELEVATED.

THE latest but probably not "last" plan of the Rapid Transit Commissioners is for a West Side electric elevated road to run up the Boulevard to One Hundred and Seventieth street.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

HANSEN'S ELECTRIC ARC LAMP.

AMONG the arc lamps recently brought out is that of Mr. F. Hansen, of Leipsic, Germany, which possesses a number of novel features.

The distinguishing feature of this lamp is a constant focus which allows the use of a small globe as represented in the illustration Fig. 1.

The regulation of the arc is effected by means of the pivotted electromagnet i which on an increase in the resistance of the lamp circuit is caused by the stationary armature o^3 to turn on its pivot to an extent corresponding to the increase of resistance and thereby release the arresting mechanism which controls the movement of the carbons.

The chain wheel around which the chain carrying the carbon holders runs, is mounted so as to oscillate with the electromagnet, but is so connected therewith that the point of its circumference where the chain carrying the upper carbon holder b^1 runs off, lies exactly in the axis of oscillation of the electromagnet. It follows from this that during the oscillatory regulating movement of the electromagnet with the chain wheel the said point, and consequently the upper carbon suspended therefrom, will remain stationary, and only the opposite part of the chain carrying the lower carbon holder b^2 will be moved according to requirement, so that the regulation of the arc will be effected by the movement of the lower carbon alone.

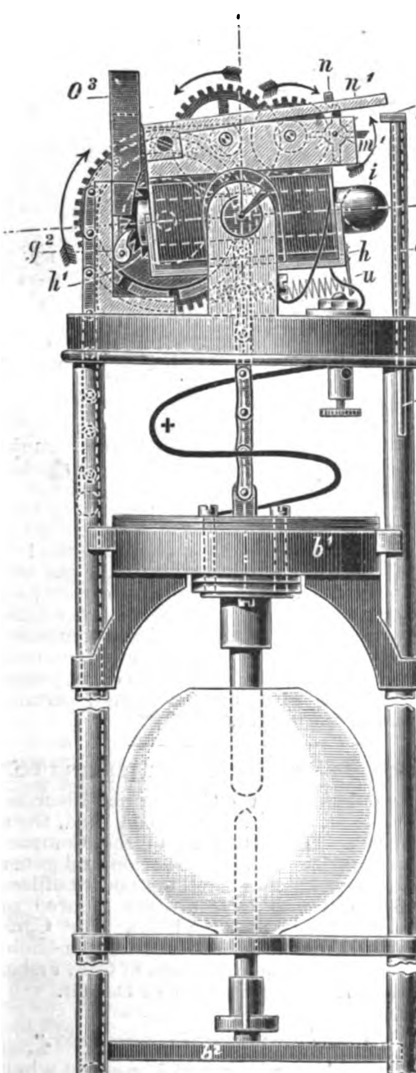


FIG. 1.—THE HANSEN ARC LAMP.

The regulating mechanism is mounted on the plate e. This plate is provided with two vertical lugs i^1, and i^2, Fig. 2, on which the frame h is supported by means of knife edges h^1 and h^2. The connecting line of these knife edges intersects the vertical axis of the carbons at right angles. In the cross pieces of the frome h is supported the horseshoe electromagnet i. In two middle pieces of the frame there is also supported a shaft on which the chain wheel runs loosely.

On one side of the chain wheel is mounted a pawl g^2 which engages in a rachet wheel fixed to the shaft of the chain wheel. On this shaft is fixed another toothed wheel which acts by means of a train of wheels upon a fly shaft which carries the star wheel

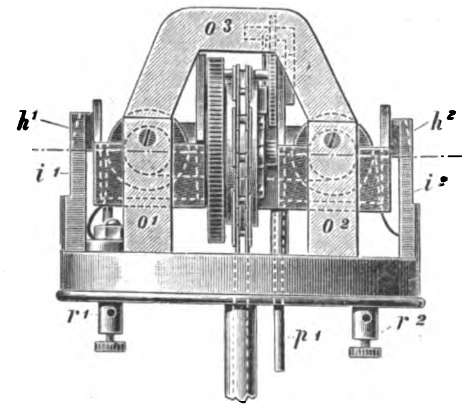


FIG. 2.—THE HANSEN ARC LAMP.

m^1 into which meshes the pawl n fixed on the lever n^1 journaled on a pin that is fixed to one of the middle pieces of the frame h. The depth of engagement of the pawl n in the star wheel m^1 can be accurately regulated by means of an eccentric disc.

On the plate e are secured two pieces o^1 o^2 to which the stationary armature o^3 are secured. There is also connected to the plate e a stop p which, on the oscillation of the electromagnet i in the direction of the large arrow, arrests the lever n^1 after the electromagnet has turned through a predetermined angle, and thereby throws the pawl n out of gear on the further turning of the electromagnet, whereupon the upper carbon holder b^1 can descend, owing to the revolution of the chain wheel and the train connected therewith being thus permitted.

To the plate e are fixed the two terminals r^1 r^2. From the positive terminal r^1 there leads a branch conductor which forms the winding the electromagnet. When the circuit of the lamp is not completed the end of the electromagnet turned toward the armature o^3 is in the lowered position shown in Fig. 1, in consequence of the preponderance of weight on this side of the axis of oscillation. When the circuit is completed and the carbons are not in proper position for forming the arc, the current passes through the branch conductor; the attraction between the electromagnet and the armature then overcomes the aforesaid preponderance of weight; the electromagnet turns on the knife edge bearings, the pawl n is thrown out of engagement, and the preponderance of weight of the upper carbon holder b^1 comes into play and causes the chain wheel to rotate in the direction of the arrow, till the two carbons come into contact. The current then passes chiefly through the main conductor, with the result, that the preponderance of weight causes the electromagnet to immediately swing back into its original position and move the lower carbon away from the upper carbon to an extent sufficient to strike the arc. In the swinging back of the electromagnet the star wheel m^1 is at the same time arrested by the pawl n whereby the chain wheel is brought to rest.

When, by the burning away of the carbons, the resistance in the main circuit increases, a correspondingly larger current will pass through the shunt circuit and the electromagnet will become more strongly energized and again commence to partly turn on its bearings, thereby moving the lower carbon nearer to the upper carbon without altering the position of the upper carbon, so that equilibrium is again established between the resistance in the arc circuit and the extent of oscillation of the electromagnet. In this manner a permanent and extremely fine regulation is effected.

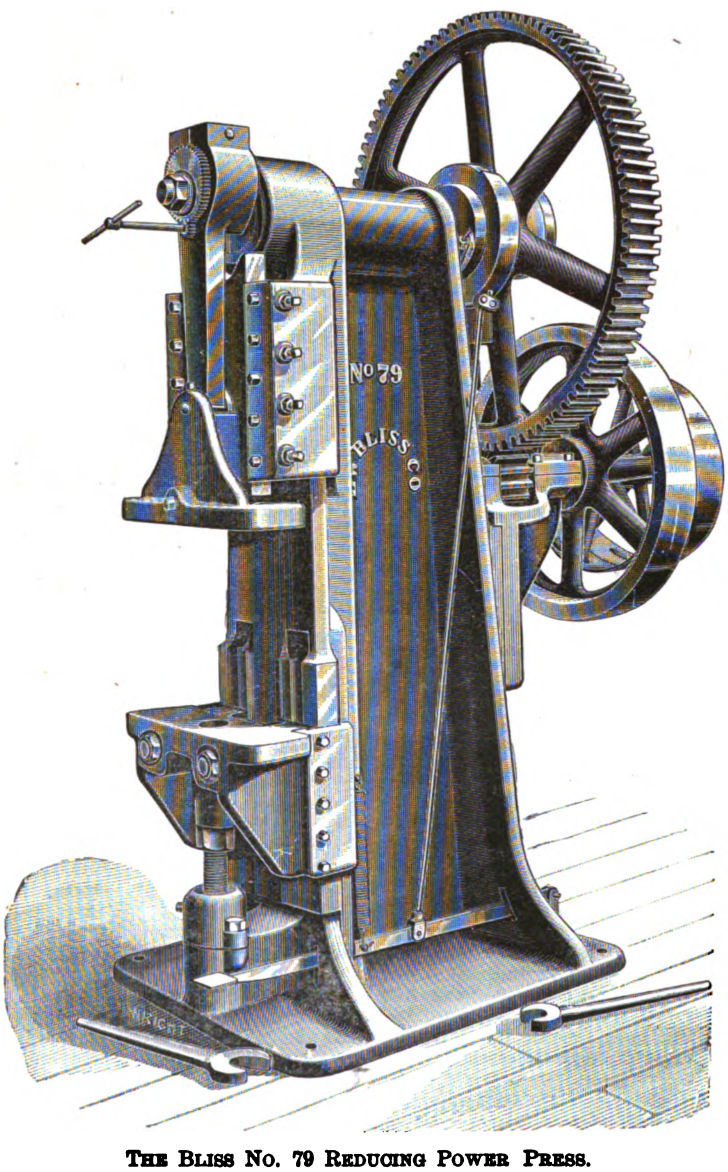
As the carbons continue to burn away the extent to which the electromagnet will turn will increase, and the lever n^1 will ultimately bear upon the stop p; and then on the further turning of the electromagnet that takes place consequent on the increasing resistance in the arc, the star wheel m^1 will be released. Then by the rotation of the chain wheel the desired supplementary regulation takes place, both carbons being moved nearer to each other in such a manner that the electromagnet swings back again in consequence of the sudden decrease of resistance in the main circuit, and the described operation of regulation begins anew.

The preponderance of weight of the frame h and electromagnet on one side of the axis of oscillation is regulated by means of a spring u, Fig. 1, so that the sensitiveness of regulation is very great.

The lamp has also been constructed as a series lamp for coupling up in parallel and also as a differential lamp. In all cases the diagram of tests has proved the regulation to be of the finest.

THE BLISS No. 79 REDUCING POWER PRESS.

THE accompanying engraving shows a long stroke press recently designed by the E. W. Bliss Co., of 145 Plymouth street, Brooklyn, N. Y., for re-drawing, shaping, trimming and other operations on deep sheet metal articles. It is provided with a screw adjustment for the table which permits the use of dies varying greatly in height, and also has an eccentric device in the pitman which facilitates making the finer adjustments required for the tools. The press is provided with an automatic clutch controlled by foot power so as to have the slide stop automatically at the top of stroke, unless continuous strokes are wanted, in which case the foot is kept on the treadle. The machine is made with or without gearing. For broaching castings or forgings, where a very slow movement is required it is frequently constructed with back gearing of much greater ratio than shown, in which case a friction clutch on the driving shaft is used, instead



THE BLISS NO. 79 REDUCING POWER PRESS.

of an automatic clutch on the crank shaft. The press, as shown in the cut, weighs about 8,200 pounds, has a maximum distance between bed and slide of 15½ inches, an adjustment for this space of 10 inches and a stroke up to 8 inches. The ratio of gearing is 1 to 7½, and the number of strokes usually made per minute, 40.

Further particulars can be obtained from the manufacturers, by addressing them at 145 Plymouth street, Brooklyn, N. Y.

MR. B. J. ARNOLD, E. E., has issued from his office in the Rookery, Chicago, a neat illustrated folder showing some of the electric railway plants upon which he has been engaged. The circular contains also a list of important properties reported on and a number of names of companies and persons of prominence to whom reference may be made. Mr. Arnold is winning a high reputation by good, solid work.

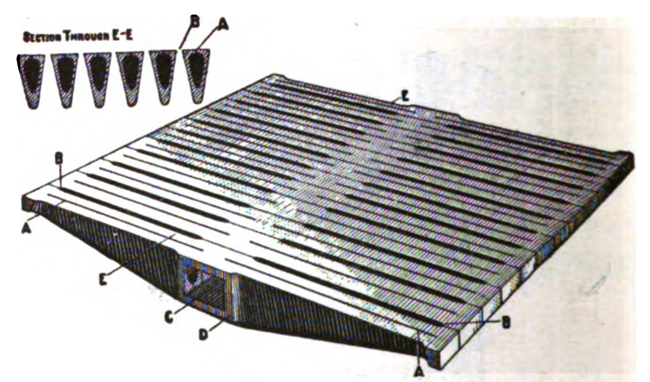
THE GADEY AIR GRATE.

THE accompanying illustration shows a grate bar made by the Brown Bros. Mfg. Co. of Chicago, and known as the "Gadey Air Grate." Broadly stated, it consists of a hollow grate bar with a slot in the upper surface next to the coal, through which oxygen is passed in sufficient quantity to create rapid and perfect combustion with the aid of natural draft. This is done by the use of a small pressure blower, which passes air in at one end of the grates directly in the center of the bars at the opening C, called the supply chamber, which is kept continuously full of air.

A narrow slot A about ⅛ inch in width runs the entire length of each grate bar, through which the air passes from the supply chamber C. The opening B is for natural draft, and is about ⅛ inch in width running the entire length between the bars, at the same time allowing for any one bar to be easily removed and a new one inserted without disturbing the other bars. A planed surface D gives an air tight joint between the bars.

With this air grate soft coal screenings when burned will, it is said, evaporate as much water as the ordinary grate bar can evaporate with one ton of the best block coal, as the air blast through the hollow grate bar carries the oxygen to every part of the mass of coal and, aided by the natural draft, produces perfect combustion.

The circulation of air through the hollow grate bars prevents them from becoming overheated and therefore the claim is made that this style of grate bar will outlast any other and that bars that have been in use for two or three months are as black to-day as when first put in, and the difference in the temperature between the grates and the coal, caused by the circulation of air, prevents clinkers from adhering to the bars. It is also said that boilers equipped with this grate are showing an increase in capacity and saving in cost of operating of from 25 to 30 per cent. over any results heretofore obtained. The Brown Bros. Mfg. Co.,



THE GADEY AIR GRATE.

through Mr. Chas. Gadey, have worked out and brought this form of air grate up to a high state of mechanical perfection. Every set of bars is thoroughly tested before leaving the works, and strong guarantees cover every installation of the system.

The Brown Bros. Mfg. Co., who have been located at the corner of Clinton and Jackson streets, Chicago, for the last 33 years were incorporated in the year of 1874, though the business was founded in 1860, and during their business career have devoted their entire time to the development of standard mechanical and engineering devices. It is the intention of the company to dispose of state and territorial rights for the sale and introduction of this grate. Mr. H. M. Underwood, has just been appointed general sales agent for the Gadey grate and all matters pertaining to the grate should be addressed to him.

COMMERCIAL ELECTRIC ENGINEERING CO.

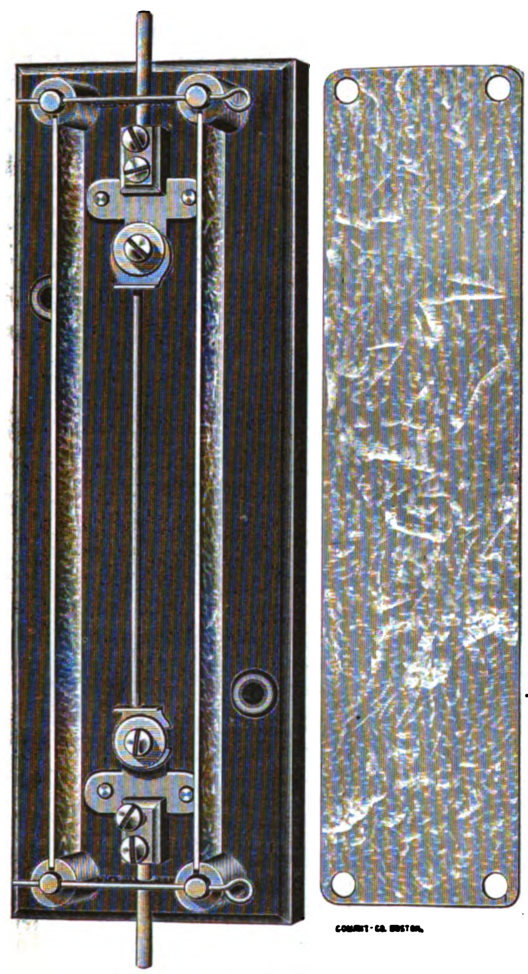
ARTICLES of Association of the Commercial Electric Engineering Company of Detroit, Mich., have been filed, the authorized capital being $50,000. The business of the Company will be that of electric engineering and construction and general electric supplies. The Company have opened temporary offices at 47 and 51 Hodges Blk., Detroit, and have already secured several contracts for central station lighting plants. The Company will represent the Standard system of arc lighting in Michigan, Ohio and Indiana and is under the management of C. E. Fisher formerly with the Commercial Electric Company of Detroit.

"THE ACME OF PHYSICAL COMFORT."

THE very acme of physical comfort is reached when traveling upon the New York Central Roads, and nowhere upon the face of the globe can more beautiful scenery be found than that disclosed by these varied routes. One never tires of the Hudson River, and the Mohawk region, so loved by poets, is always a feast to the eye and a delight to the soul. Then as we go on and keep our eyes open we come upon some of the loveliest sheets of water on top of the earth—Cayuga Lake for one, and farther on, Canandaigua Lake, uniquely and blissfully situated.—*Eleanor Kirk.*

A NEW HILL COVERED FUSE BOX.

For some time there has been a demand for a covered fuse box, as the Boards of Underwriters in the various cities have begun to insist upon the placing of fuses in such receptacles as would prevent the melted metal resulting from the blowing of a fuse from running out and possibly dropping on inflammable material. Such a covered fuse box for use on 500 volt circuits is shown in the accompanying illustration, and has been perfected and placed on the market by the W. S. Hill Electric Company of Boston, the well known manufacturers of switches and switchboards. The metal terminal blocks are mounted on a slate base, and the parts are all protected by a box made of mica, the removable cover of which is held in place with two wire pins, so as to be readily removed to admit of replacing a blown fuse. The whole design is light and serviceable and fills a distinct want and there is little doubt but that it will be readily adopted by progressive electrical engineers. It certainly reflects credit on the W. S. Hill Company's ability to keep abreast of the times and to easily and quickly produce any article that is in actual demand.



New Hill Covered Fuse Box.

DO YOU WANT A MATCH SAFE?

A neat match safe, made of leather, suitable for the vest pocket and carrying a subtle but striking advertisement of "Okonite" is being distributed by the Central Electric Company, 116 and 118 Franklin street, Chicago. Besides being a striking advertisement for "Okonite," for which this company are general western agents, there is provided on the covering flap a good place for striking matches.

CENTRAL ELECTRIC COMPANY.

The Central Electric Company report large sales on the various grades of P. & B. paints and varnishes, which they are handling as general western agents for the Standard Paint Company. Their stock represents the different grades of these products, put up in packages ranging from one gallon to a barrel.

NEW YORK NOTES.

Mr. G. H. Almon, of 136 Liberty street, has been awarded the contract for the lighting plant of the Vermont State Asylum for the Insane at Waterbury, Vt. The contract includes the engine as well as the generator and the plant will supply 500 incandescent lights. Mr. Almon has also secured the contract for a 25 light plant for the Lanes Mills at Lanesboro, Vt., and a 60 light plant for Bogle & Scott, of this city. Mr. Almon is now the selling agent for the Belknap Motor Co. and the "L. P. & D." Transmitter Co.

The John Wennstrom Co., of 41st street, between 3d and 4th Avenues, Brooklyn, are prepared to furnish jewels for scientific purposes, electrical measuring instruments, etc. They occupy a factory specially equipped for their needs, and are probably the only company in this country engaged in this line of work. They manufacture sapphire dies for cutting fibre and ruby draw plates.

Mr. R. T. McDonald, of the Fort Wayne Electric Co., has been indicted by the New York Grand Jury as one of the directors of the broken Madison Square Bank. He has entered a plea of not guilty to the eleven counts of the indictment. He is represented by Mr. W. B. Putney, who is well known in electro-legal circles.

Interior Conduit is in very active demand. The Interior Conduit and Insulation Company shipped during the month of October 1,012,500 feet of tubing, of which 45 per cent. was plain and 55 per cent. armored. The orders on Nov. 27 were 104,000 feet for the single day.

The Caldwell water tube boiler, manufactured by John A. Caldwell, 41 Cortlandt street, New York, is now being manufactured for the West by the Link Belt Machinery Co., of Chicago, with sales agencies in the principal cities.

Mr. P. H. Alexander was in New York City last week. He now has an office at Room 808 Equitable Building, Baltimore, where he is practicing as an electrical engineer, preparing plans, specifications, estimates, etc.

WESTERN NOTES.

Messrs. Cushing & Morse, General Western Agents for Day's Kerite wires and cables, 225 Dearborn street, Chicago, are distributing to the trade and friends, a new device for determining at sight the size of wire required for any number of incandescent lamps any distance from point of distribution. It is not a cumbersome book of tables, but consists of two cardboard discs on a single pivot. The user simply multiplies the distance by the number of lamps, and the result is the number of lamp feet. He then turns the disc to the nearest corresponding number, and the size of wire wanted, at any percentage of loss, is at once indicated.

As there may be many persons in their territory whom they have overlooked unintentionally they desire that all such send in their address, when they will receive this really valuable article.

The Central Electric Company reports that their sales on "Anti-Thunderbolt" oil paper show a large and increasing demand for a product of this nature which is absolutely reliable. This paper is a preventive for short circuits and grounds when used in winding armatures, fields and converters, and is unsurpassed for electric manufacturing and repairing. It will resist the highest voltages, also the action of oil, water and dampness and the injurious action of chemicals and gases and it does not crack or tear when folded. The genuine oil paper is stamped "Anti-Thunderbolt."

The Metropolitan Electric Company are receiving a great many orders for the Paiste adjustable clutch for Thomson-Houston arc lamps. This, it is said, is the only clutch that can be adjusted to the carbon rod, and can never wear out. They are also selling the Paiste lower contact bushing for Thomson-Houston arc lamps for insuring a perfect contact to the carbon rod without the aid of small brushes.

The Salem Electric Light and Power Co., of 17 Locust street, Salem, Ohio, have just closed a contract with the city to put up and operate for ten years, 100 arc lights of 1,200 c. p., to displace the old system of 325 incandescent lamps of 25 c. p. The new installation will be complete by the first of next February.

SOUTHERN NOTES.

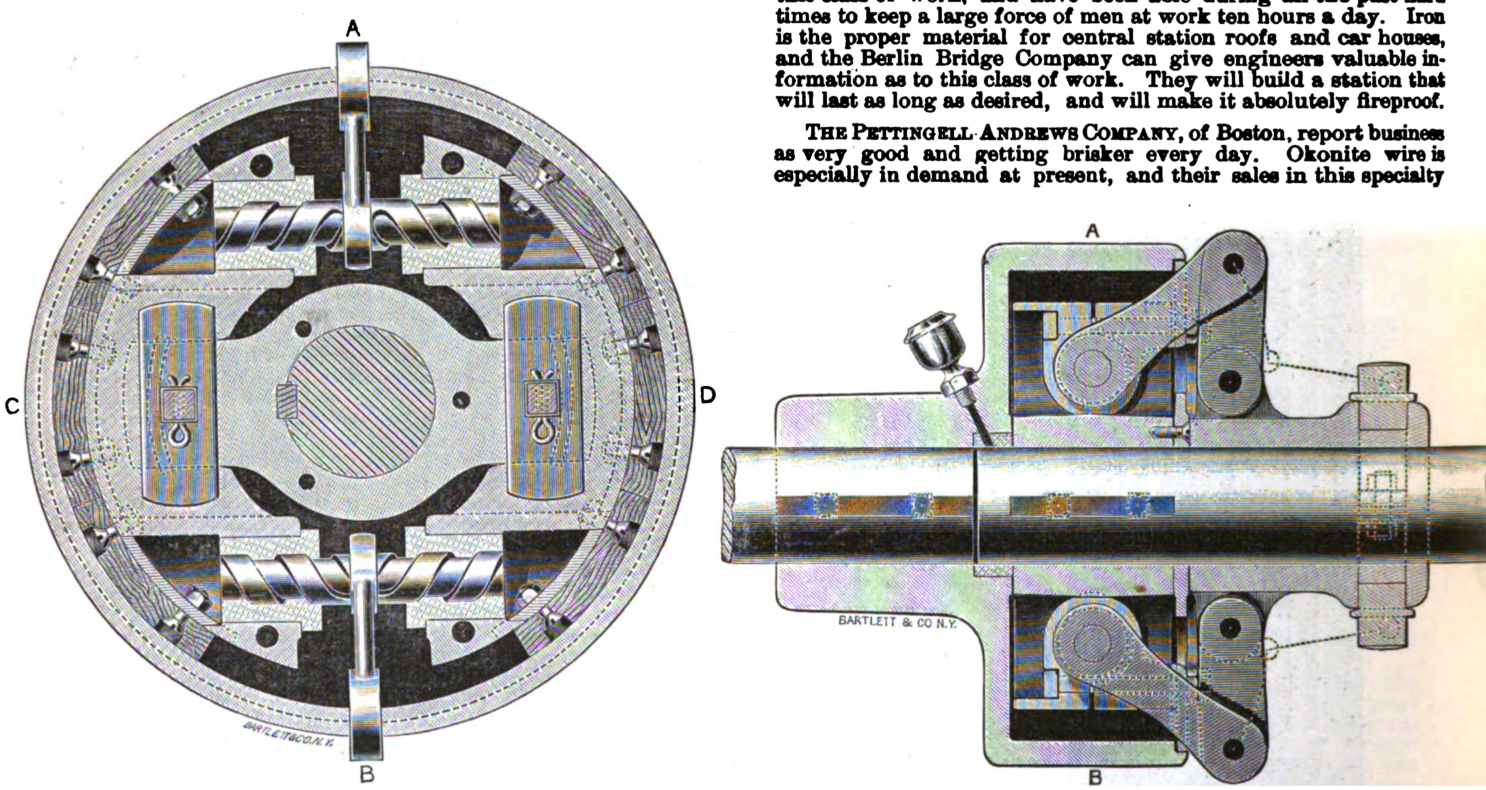
The Ries Electric Specialty Company, of Baltimore, Md., the manufacturers of the well-known Ries regulating sockets and switches, have removed their offices and factory from their old quarters at the corner of Baltimore and Eutaw streets, to the large and commodious Gunther Block, No. 7 South Gay street, where they have installed additional machinery and will have ample room and largely increased facilities for manufacturing the goods which their growing trade demands. In addition to its established products, The Ries Electric Specialty Company is now busily engaged in manufacturing the new Ries & Scott single phase alternating current motors, for which the company has numerous orders already booked for early delivery. The smaller sizes of these motors will shortly be ready for the market and will be rapidly followed by others of larger capacity.

GIFFORD'S PATENT SCREW-FRICTION CLUTCH.

In describing this clutch it is unnecessary to mention the advantages which every good article of its kind confers upon the user. They are now so well recognized in their convenience, economy and power that the only question is as to which possesses the greatest merit.

The power of a screw is employed for creating pressure and this, together with the powerful leverage used to rotate the screw, enables it to weld, so to speak, the face of the driving segments to the interior face of the driven drum. The screw and lever-arm are in one piece and, with their nuts, are of aluminum bronze. Wooden lags of hard maple are employed to obtain the best frictional results. It is said that the wear on them is practically imperceptible, and, granting that they might wear, they can be replaced easily and at very slight expense.

The clutch is compact and requires but little space on the shaft and the adjustment, when necessary, is readily made. The patentees and manufacturers, Gifford Brothers, of Hudson, N. Y., have contracted with the Suburban Electric Co., Elizabeth, N. J., of which Mr. A. M. Young, of Waterbury, Conn., is president, for the installation of counter-shafting, clutch pulleys, quills, cut-off couplings, etc., in their model electric light and power plant now being constructed.



Figs. 1 and 2.—Gifford's Patent Screw-Friction Clutch.

Figs. 1 and 2 illustrate sectional views of the clutch, from which our readers will obtain an excellent idea of the simplicity and efficiency of its mechanism.

THE CONNECTICUT ROYAL ARC CO.

After a thorough trial lasting over several months, both on street lights and in the laboratory, the Hartford Electric Light Co., of Hartford, Conn., of which Mr. A. C. Dunham is president, has closed a three years' contract with the Royal Arc Light Co. of New York, for the use of the Howard "incandescent arc" light device on all of its arc lamps, numbering 860 in all. The trials have shown that the lamps require trimming only once a week and the adoption of the system by such a conservative company speaks volumes for its merits. Owing to the manner in which the arc is enclosed, no sparks can escape under any possible conditions, and this feature is particularly commended and approved of by the fire underwriters.

The Connecticut Royal Arc Co., of Hartford, are the licensees of this system for the State of Connecticut. The general manager of the company is Mr. J. J. Gates, who has had a large experience in electric lighting, having been with the Mather Co. in 1888, then general manager for the Perkins Electric Lamp Co., and until recently secretary and manager of the Waring Electric Co., manufacturers of the Novak lamp.

PHILADELPHIA NOTES.

The Lehigh University has just completed its new electrical laboratory. The building is of cut stone and cost over $200,000. Its interior is fitted especially for electrical work in all its branches. Mr. C. J. Miller, electrical engineer, of this city had charge of the electrical installation work.

Mr. G. F. Coleman, who for some time past has been connected with the Brush Electric Co., and Sperry Electric Railway Co. of Cleveland, O., has been engaged by the La Roche Electric Works to act as assistant superintendent of installation.

The Southern and Planters' Hotels at St. Louis are making additions and alterations in their houses and both have adopted the Partrick & Carter return call annunciator.

Mr. Chas. Blizard, late general manager for the Franklin Electric Co., of New York, has accepted a position with the Electric Storage Battery Co. of this city.

NEW ENGLAND NOTES.

The Berlin Iron Bridge Company, of East Berlin, Conn., have evidently made their iron roofs for central station work extremely popular, as they have now several orders on hand for this class of work, and have been able during all the past hard times to keep a large force of men at work ten hours a day. Iron is the proper material for central station roofs and car houses, and the Berlin Bridge Company can give engineers valuable information as to this class of work. They will build a station that will last as long as desired, and will make it absolutely fireproof.

The Pettingell-Andrews Company, of Boston, report business as very good and getting brisker every day. Okonite wire is especially in demand at present, and their sales in this specialty have been exceptionally large for the past few weeks. While the larger factories are still feeling the dull times, supply houses are getting a good trade presumably because the central stations and constructing engineers have all let their stock of goods run down to a very low point, and are now ordering for immediate use.

The Hart & Hegeman Manufacturing Company, of Hartford, are having a heavy run on their specialties and have hard work to keep up with their orders, even though they have a large force of men at work. The Hart snap switch appears to have become a favorite, North, South, East and West, and Mr. Hart is busy getting out some larger sizes which will undoubtedly please electricians when they see them.

The Eddy Electric Manufacturing Company, of Windsor, Conn., are working ten hours a day with about three quarter of their usual force, and report business as very good, with excellent prospects. Their work is getting larger and heavier every day, and their shop is now filled with heavy castings which will soon become powerful electric railway generators.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

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THE LIMITATIONS TO LONG DISTANCE TELEPHONY.— I.

BY

H. W. Dunbar

It has many times been shown that under certain conditions the effects of distributed capacity may be neutralized by distributed retardation. Such being the case it is evidently of especial interest in telephony in which exceedingly high rates of alternation exist and therefore the loss due to the distributed capacity is a maximum.

The limitation to the transmission of speech by telephone has been frequently stated to be due to three separate causes, either one of them sufficient of itself to limit the distance to which successful conversation can be carried on. The causes stated are:

1. Tones of varying pitch will, on account of the capacity of the line, be transmitted with varying rapidities and the resultant wave at the receiving end will be distorted on account of a displacement of the phases of the component parts.
2. Tones of varying pitches suffer varying amounts of loss upon the line due to the distributed capacity, and consequently the resultant wave is distorted by the undue prominence of the lower tones.
3. The value of the current itself decreases as the distance from the transmitter increases and at some point will have become too weak to affect the receiving instruments.

The object of these articles is to discuss these limitations and to determine the conditions under which the current at the distant end may be increased by an increase in the retardation of the circuit.

We will discuss a metallic circuit of length l and subject to an alternating source of E. M. F., $e = E \sin \omega t$, where, as usual, ω represents $2 \pi n$, n being the number of complete alternations per second.

Then the E. M. F. at any distance, x, from the origin and and at any time, t, is given by

$$e = \left\{ \frac{\varepsilon^{2pl} - \varepsilon^{pl} \cos al}{1 - 2 \varepsilon^{pl} \cos al + \varepsilon^{2pl}} \left[\varepsilon^{-px} \sin (\omega t - ax) - \varepsilon^{-p(l-x)} \sin \left\{ \omega t - a(l-x) \right\} \right] + \frac{\varepsilon^{pl} \sin al}{1 - 2 \varepsilon^{pl} \cos al + \varepsilon^{2pl}} \left[\varepsilon^{-p(l-x)} \cos \left\{ \omega t - a(l-x) \right\} - \varepsilon^{-px} \cos (\omega t - ax) \right] \right\} \quad (1),$$

where $p = \sqrt{\frac{c\omega}{2}} \sqrt{(R^2 + L^2 \omega^2) - L\omega}$

and $a = \sqrt{\frac{c\omega}{2}} \sqrt{(R^2 + L^2 \omega^2)^{\frac{1}{2}} + L\omega}$ and

R = resistance in ohms per unit of length (mile).
L = inductance in henrys " " "
C = capacity in farads (to ground) " "
also E = Naperian base, 2.718 +.

This equation takes no account of the leakage of the line. In practice in ordinary weather the leakage is so slight that it may be completely ignored. In exceptionally wet or foggy weather it may appreciably weaken the current at the distant end. It also tends to produce a more uniform rate of decay of the current for varying pitches, but its effect is always in one direction and generally so slight that it may be neglected. We may then consider it simply as a correction term and omit it in the general formulæ.

The corresponding complete current equation could be at once written from the consideration that the rate of decay of the current with the distance from the origin is equal to the rate of change in the charge held by the capacity of the line; or that $\frac{d\,i}{d\,x} = C \frac{d\,e}{d\,t}$. But this general E. M. F. equation may be simplified and still remain applicable to all important cases in telephony.

If the length of the circuit be such that the waves of E.M.F. which at each alternation are sent out simultaneously on both conductors of the circuit, again arrive at the origin just as similar waves are leaving, then a maximum current will result for that particular rate of alternation on that particular line; for the main wave and the smaller "repeated" waves coincide in phase and are added together algebraically. Should, however, the smaller repeated waves arrive again at the origin in exact opposition to the main waves a minimum current for the same set of conditions would result. Between and including these two extremes all cases lie, where the length of the circuit is equal to, or exceeds, one-half a wave length.

Now from (1) we find the wave length to be expressed by x when $ax = 2 \pi$, then $x_\lambda = \frac{2 \pi}{a}$, or $a = \frac{2 \pi}{x_\lambda}$ where x_λ is the wave length. Then, when for a given set of conditions the current is a maximum, $l = (K + 1)\, x_\lambda$, and when a minimum, $l = \left(\frac{2K + 1}{2}\right) x_\lambda$, where K is zero or any positive whole number.

Therefore, when the current is a maximum $a\,l = 2 \pi (K + 1)$, whose sine is 0 and cosine is 1; and when the current is a minimum $al = 2 \pi \left(\frac{2K + 1}{2}\right)$ whose sine is 0 and cosine is -1.

Substituting these values in the general equation we have for a maximum and minimum respectively.

$$e = \frac{E}{\varepsilon^{pl} \mp 1} \left\{ \varepsilon^{pl - px} \sin (\omega t - a x) \mp \varepsilon^{px} \sin(\omega t + a x) \right\} \quad (2)$$

This shows us that the middle point of the circuit is always at zero potential or half way between the potentials of the origin at any instant. Also that as the capacity of the circuit approaches zero the potential on the line falls uniformly according to the law of distributed resistance and inductance, or $e = E \left(1 - \frac{2x}{l}\right) \sin \omega t$.

Remembering that $\frac{di}{dx} = C\frac{de}{dt}$ we may write the maximum and minimum values of the current for any time and at any distance from the origin as follows:

$$i = -\frac{E\sqrt{c\omega}}{\sqrt{R^2+L^2\omega^2}\,(\varepsilon^{pl}\mp 1)}\times \qquad (2).$$
$$\left[\varepsilon^{pl-px}\sin\left(\omega t - ax + \tan^{-1}\frac{p}{a}\right) \pm \varepsilon^{px}\sin\left(\omega t + ax + \tan^{-1}\frac{p}{a}\right)\right]$$

The negative sign before the right hand member indicates simply that the direction of "flow" of the current is opposite to an increase in potential.

The value of the current at the transmitting end is given when $x = 0$:

$$i = -\frac{E\sqrt{c\omega}\,(\varepsilon^{pl}\pm 1)}{\sqrt{R^2+L^2\omega^2}\,(\varepsilon^{pl}\mp 1)}\sin\left(\omega t + \tan^{-1}\frac{p}{a}\right) \quad (3).$$

As before, the maximum and minimum values are represented by the upper and lower signs respectively.

The value of the current at the distant end is given when $x = \frac{l}{2}$ and represents the efficiency of the circuit for telephonic purposes. Substituting $x = \frac{l}{2}$ we have for the maximum value of i for the given set of conditions:

$$i = -\frac{2E\sqrt{c\omega}}{\sqrt{R^2+L^2\omega^2}\,(\varepsilon^{pl}-1)}\times \qquad (4).$$
$$\left\{\varepsilon^{\frac{pl}{2}}\sin\left(\omega t - \frac{al}{2} + \tan^{-1}\frac{p}{a}\right)\right\}$$

We see that the current always precedes the potential by an angle varying from 0 to 45 degrees as the inductance of the circuit decreases from infinity to zero. As the capacity approaches zero the current becomes uniform and equal to

$$i = -\frac{2E}{l\sqrt{R^2+L^2\omega^2}}\sin\left(\omega t + \tan^{-1}\frac{L\omega}{R}\right) \quad (5).$$

We are able now to take up the discussion of the equations with reference to the limitations to the extension of long distance telephony.

1. The stated limitation due to the distortion of the wave owing to the displacement of the phases of the component parts.

An examination of equation (4) shows us that when, as per assumption, $al = 2\pi\,(K+1)$ the term $\frac{al}{2}$ vanishes, and when $K = 0$ it also changes the sign of the current, thus indicating that the phase of the current at the middle point of the circuit is in exact opposition to the phase at the origin when the wave length is equal to the circuit length.

If, however, $al = 2\pi\left(\frac{2K+1}{2}\right)$, $\frac{al}{2}$ will be equal to 90 degrees or some odd multiple of 90 degrees and hence (4) will reduce to

$$i = -\frac{2E\sqrt{ca}}{\sqrt{R^2+L^2\omega^2}\,(\varepsilon^{pl}+1)}\times$$
$$\left[\varepsilon^{\frac{pl}{2}}\sin\left\{\omega t - 90^\circ + \tan^{-1}\frac{p}{2}\right\}\right] \qquad (6),$$

which is evidently zero when (4) is a maximum, for (4) and (6) differ in phase by 90 degrees.

From equation (2) we may find the wave length from any particular case by equating to 2π the term containing the distance variable in the angle. Thus

$$ax_\lambda = 2\pi;\ \text{or}\ x_\lambda = \frac{2\pi}{a} = \frac{2\pi}{\sqrt{\frac{c\omega}{2}}\ \sqrt{(R^2+L^2\omega^2)^{\frac{1}{2}}+L\omega}} \quad (7).$$

From which we see that the wave length varies inversely as some power of the frequency; this power changing from the ½ to the 1st power as the self-induction increases from zero to infinity. Thus we see that the greater the self-induction, the greater will be the phase difference of the component parts of a tone.

Introducing the constants obtained on the New York and Chicago line and a value of $L = .0016$ henrys per mile[1] we have for a tone of 160 vibrations per second (a tone but little above the fundamental of the average male voice)

$$x_\lambda = \frac{6.28}{\sqrt{\frac{.017}{10^6}\times\frac{1000}{2}}\ \sqrt{(2.2^2 + \{.0016\times 1000\}^2) + 1.6}}$$

$= 1{,}060$ miles; thus giving approximately a single wave length between New York and Chicago. The octave or first prominent overtone of this note would have a wave length of

$$x_\lambda = \frac{6.28}{\sqrt{\frac{.017}{10^6}\times\frac{2000}{2}}\ \sqrt{(2.2^2 + \{.0016\times 2000\}^2) + 3.2}}$$

$= 585$ miles.

These values correspond to values of $l = 2x_\lambda$ and $l = 3\frac{1}{2}x_\lambda$ and therefore are represented by equations (4) and (6) respectively. That is, the fundamental and first prominent overtone of the male voice reach the receiving instrument at Chicago with a difference in phase of 90 degrees. When the octave is zero the fundamental is a maximum, and vice versa.

The remaining component parts of the complete tone arrive with their phases varying throughout the entire 360 degrees. The resultant tone should be perfectly inarticulate if any such action limited in any degree the transmission of speech or music telephonically.

But the displacement of phase in the case cited is similar to that which exists whether a person listens to a vocal duet from a distance of 20 or 21 feet from the performers. Pitch 160 and its octave will vary from coincidence to a difference of 90 degrees in phase by the change in position. The ear is an analytic organ and appreciates the component parts of the complete wave whatever their phase difference may be. We may fear no limit to telephony from this cause.

E. M. F. IN ELECTROLYTIC ANALYSIS.

Mr. H. Freudenberg, in the *Zeit. Physical. Chem.*, deals with this subject: It has been shown that different values of the E. M. F. are necessary to electrolytically decompose aqueous solutions of different salts. In some cases the electrolytic separation of two metals from a mixed solution of their salts may be effected by choosing an E. M. F. just sufficient to decompose one salt, but insufficient to decompose the other. The author has made a large number of experiments on this subject, and has succeeded in effecting the separation, in acid solution, of various metals which show normal decomposition values of the E. M. F. Thus, silver may be separated from arsenic and bismuth; mercury from copper, bismuth and arsenic; and, finally, copper and bismuth from cadmium and arsenic. Solutions with abnormal decomposition values were also investigated,

1. See Mr. A. E. Kennelly's paper on "Impedance" read before the A. I. E. E., April 18, 1893.

without practical result in the case of the oxalates, phosphates, and ammonium double salts. Cyanides and sulpho-salts, however, often give methods of separation. For example, silver may be separated from antimony, and mercury from copper and cadmium in potassium cyanide solution, and mercury may be separated from antimony and arsenic in ammoniacal solution.

FROSTED AND COLORED INCANDESCENT LAMPS.

BY

Charles Wirt

As appropriate to the Christmas season the following note on the subject of frosting and coloring incandescent lamp globes by one who has been over the ground pretty thoroughly will possibly be of use to some who wish to do this work for themselves.

But one entirely satisfactory method of frosting lamps is known and that is the process of etching with some form or combination of hydrofluoric acid. Lamps have been cut by the sand blast process but this is very severe and in a thin globe is liable to cut through the glass entirely, or so weaken it that the pressure of the air will cause it to break. Hydrofluoric acid is sold in this market in gutta percha bottles holding about one pound. Like hydrochloric acid the liquid consists of an aqueous solution of the gaseous acid.

To one who intends to make use of this extremely energetic agent, the advice of *Punch* to those about to marry will apply with full force, viz., "Don't." It is extremely dangerous to handle, being a violent poison and the fumes very irritating to the lungs, while the consequences of getting the liquid into a scratch on the skin might be serious. Moreover, in spite of the prevalent idea, the *liquid* hydrofluoric acid, properly speaking, will not *etch* glass. It will *eat* glass, and that with avidity, but the surface remaining, though somewhat uneven, will not be found to be frosted or etched. Workers in fancy glass use a compound of the liquid hydrofluoric acid which goes by the name of "white acid." This liquid will etch glass which is dipped into it. It can be obtained from dealers in stained glass, etc., but requires to be freshly prepared as it loses its efficacy by standing a few days. To etch lamps with white acid it is best to prepare a rack into which the lamps can be screwed standing in a vertical position with the bulbs downwards. The best results will be obtained if the current is supplied to the lamps so that they may be burning while they undergo the operation. A lead dish must be provided sufficiently large to admit the entire lamp and filled with the white acid to the proper depth to cover the lamp when immersed in the vessel. Thus arranged it becomes unnecessary to handle the wet lamp as the vessel can be brought up from below, allowing one lamp after another to dip into the acid. The heat from the incandescent filament makes the acid act more energetically and more evenly over the surface of the glass. If a single application of the acid to the lamp does not seem to give the desired effect, the depth of the etching can be increased by a second application.

Etching can also be accomplished very successfully, although not so easily, by using the gaseous hydrofluoric acid. For this purpose it is necessary to generate the acid as it is used, which can be done by placing in a leaden dish a little powdered fluorspar and adding diluted sulphuric acid, and then heating the mass gently in a sand bath. This should be done in a good draught of air to carry the fumes away from the operator. The vessel used should be a straight piece of lead tube about 8 inches long with a lead bottom properly burned in and having a cover of asbestos or rubber with a hole just large enough to admit the neck of the lamp. Small quantities of the material should be placed in the vessel at a time, and no more of the gas generated than is sufficient to do the work. The lamp should be perfectly clean and should be placed in the vessel after dipping in water. The wet surface appears to favor the uniform distribution of the etching effect. This process is very troublesome and slow. It cannot be recommended if the white acid can be obtained.

A temporary etching effect can be obtained on lamps by dipping them into solutions of various salts and allowing the same to dry on the surface. Epsom salts are perhaps as good as any for this purpose. This process is not satisfactory as the surface obtained is very easily soiled and easily rubbed off. The etching with white acid is so easy and cheap where considerable quantities of lamps are operated upon that there is little need for substitutes.

The best way to color lamps, to use a Hibernicism is to buy lamps made with glass of the color desired. These cost more than plain lamps or lamps colored with varnishes, but the superior brilliancy of "pot metal" color is sufficient to make it worth while. For Christmas trees and other temporary effects lamps may be varnished with collodion colored with aniline dyes. The family dyes, as sold in packages at drug stores, answer very nicely for this purpose. The advantage of collodion over other mediums for the purpose is that the solvent, viz., alcohol and ether, dissolves the dyes very perfectly. The collodion flows smoothly, and if hardened by heat is quite durable. Lamps which are to be colored should be cleaned with particular care and should be perfectly dry before applying the color. They should be placed in sockets with the bulbs downwards and the coloring material, contained in a deep narrow vessel, brought up over the lamp from below. After drying a few minutes the current should be turned on the lamp and ten or fifteen minutes will be sufficient to thoroughly harden the coating. Without this hardening by heat the coating is fragile and easily rubbed off. If not sufficiently deep in color after the first application, a second or a third application may be made.

It is advisable that colored lamps should be burned at a low efficiency for the reason that the coloring intercepts the heat which is freely radiated through the clear glass, the result being that the temperature of the bulb is raised considerably and if lamps are burned at the full brilliancy the heat will be sufficient to deteriorate the coloring varnish. Such colors begin to fade in any case and after a few days of burning will be found to be comparatively dull. The light emitted is in any case of slight importance as nothing is wanted beyond a luminous colored effect; accordingly nothing is lost by burning the lamp somewhat below the full incandescence and the life of the color is prolonged. This color can be readily washed off with alcohol if required. Lamps which are used for a time as colored lamps may be thus cleaned and do duty afterwards as plain lamps. Red and blue are favorite colors and both give a clear transparent tint when used according to these directions. Orange gives a frosted effect, not transparent but very pretty and effective.

Let the novice in color effect take the advice of some friend with artistic tastes before deciding what colors can be used together harmoniously, lest he rush in where angels fear to tread and produce an effect more pleasing to the savage than the cultivated eye.

LIGHTING THE IMPERIAL AUSTRIAN TRAIN.

The imperial train is made up of eight cars in all, beginning with a baggage car which also contains a special compartment for the conductor and the electric plant for lighting the train. The current for lighting the cars is furnished both by dynamo and by storage battery, the arrangement being such that the latter comes into action if through any cause the operation of the dynamo should become interrupted.

A NOVEL METHOD OF DRIVING DYNAMOS FROM TURBINES.

BY

John R. Markle

WHERE the head of water is less than 20 feet, the vertical shaft water wheel only can be used to advantage. Heretofore cog gearing has been employed to transmit the power and increase the speed. This is objectionable owing to loss of power from friction, burning out of wheel steps and consequent contingent liability of stripping and ruining the gears, and constant pounding which greatly increases leakage of flumes and penstocks and shortens their life very materially. The device here illustrated does away entirely with cog gearing and makes of the vertical wheel shaft, what the pinion shaft is with cog gearing arrangement. Therefore the friction due to the cog gearing is entirely dispensed with together with its noise, risks and losses.

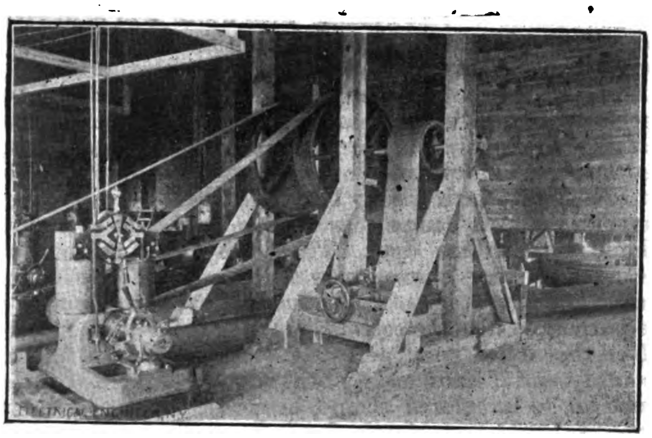
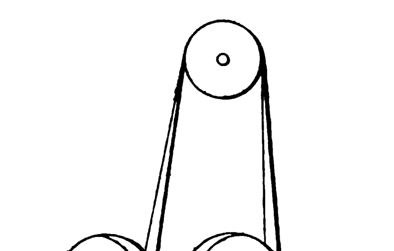


FIG. 1.—DYNAMO DRIVING FROM VERTICAL TURBINE.

In the engraving, Fig. 1, is clearly shown the large driving wheel mounted direct on the water wheel shaft having bearings above and below the wheel.

This apparatus was arranged by the writer and built for the Edison Lighting Company of Allegan, Mich., during the past season, and appears to be practically a new type of power transmission device. It is arranged to drive two Edison 25 k. w. dynamos from a turbine water wheel of the vertical shaft type.

The turbine is a 60 inch American wheel. The main driving belt is one of Munson's selected leather belts, 16 inches wide, 70 feet long and endless. Fig. 2 shows the arrangement of the idler frame and shafting device in detail. This frame carries two idlers 24 inches in diameter and 18 inch face, one of which receives the main belt on its under side, and at the rear, near the frame, has a shifting hand wheel and screw. This idler is set on the sliding portion of the frame, to which is attached the hand wheel and screw. The screw passes through a fixed nut anchored in the stationary portion of the frame. When the screw is turned to the left, the sliding portion of the frame is drawn back, together with the idler thereon and tightens the belt, and vice versa. The belt passes up and over the countershaft driving pulley which is 26 inches in diameter and then down in front and under the second 24 inch idler pulley set on the fixed portion of the frame, and from there to the main driving pulley on the water wheel shaft. The main driving wheel is 10 feet in diameter, 18 inches face; the speed of the water wheel 55 to 70 turns per minute. The dynamo driving pulleys on the countershaft are 60 inches in diameter, 12 inches face. All the pulleys are of wood and made by the Dodge Manufacturing Co. of Mishawaka, Ind., which firm designed and built the idler frame and its appurtenances.



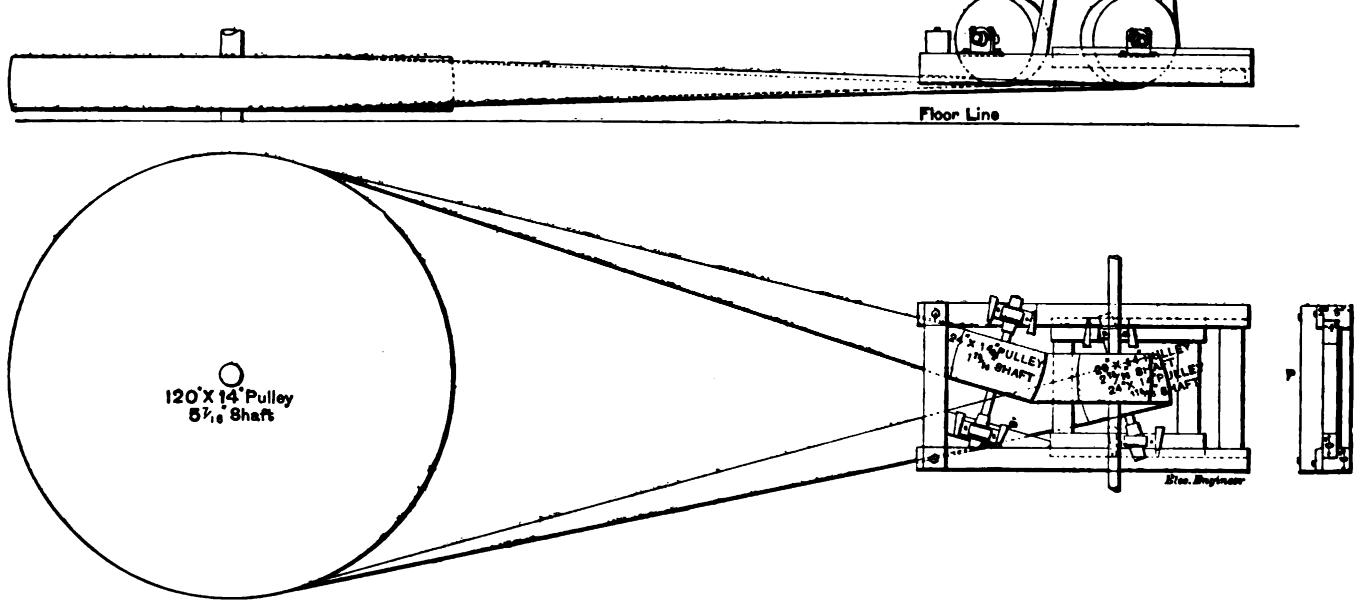


FIG. 2.—MARKLE METHOD OF DRIVING DYNAMOS FROM VERTICAL TURBINES WITHOUT COG GEARING.

This device works smoothly and from its first operation has not caused a shut-down nor shown a hot box. The only noise to be heard from its operation is the slight shuffling of the dynamo belts, which, however, being run on wood surface dynamo pulleys, is reduced to the minimum.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRICITY ON THE ERIE CANAL.

BY

F. W. Hawley

I HAVE frequently been asked my views lately in reference to the improvements of the Erie Canal by the introduction of electricity thereupon for the propulsion of canal-boats. At the outset let me say that the experiments recently made at Rochester were entirely satisfactory and fully demonstrated the possibility and practicability of applying electricity in navigating the Erie. There was no question in the minds of any of us but that this could be accomplished, but the opposition which seemed to be found to the introduction of electricity was so marked that a practical demonstration was necessary. It is entirely practical to construct a pole line along the entire length of the Erie Canal, suspend span wires and attach an over-running trolley wire and by means of a flexible wire convey electricity to a motor attached to the shaft operating a propeller wheel.

The Canal as is exists to-day, can do many times the volume of business which it is now called upon to accommodate; the only question is as to the economy with which electric power can be delivered to the boatmen. It is believed by those interested in the experiments mentioned that this power should be communicated by a current conveyed directly and not by means of the storage battery system. Nor do they consider it advisable to tow the boats at the end of a hawser by operating an electric motor upon a track on either bank of the canal, for the reason that such an erection on the tow path side would interfere with the present mode of propulsion, namely, horse power, and upon the berm bank, for the reason that it is so irregular that an enormous expense would be incurred in its reconstruction and enforcement. Wide waters occur frequently, basins and inlets are found every few miles and it would cost an enormous sum to maintain a bank on that side upon which to construct, maintain and operate a track or tramway. Canal boats as they exist to-day are of the type most suitable for economy; they carry a very substantial load, are built at moderate cost and can be purchased by almost any industrious and energetic man; the investment to him is small; he is his own captain and pilot; he can be his own motorman with the trolley system, thus dispensing with half of his crew. The quarters of the crew can be so reduced as to add considerably to the storage capacity, to which will be added much of the space now occupied in the steamboats by the engine, boiler and fuel,—and in horse boats, by the quarters of the animals and forage storage.

The canal as it exists to-day, affords therefore an opportunity for anyone so inclined to engage as a carrier in the great traffic of grain transportation between the great lakes and the seaboard. It is desirable, however, to increase the capacity of the canal, by, to some extent, increasing the speed of the boats. The most practical plan for substantial improvement is by bottoming out such levels of the canal as it is found practical so to do by taking from the bed at least a foot and raising the levels of the embankments a foot. This will give two feet more water in the canal and two feet more under the propeller wheel, which furnishes additional resistance and facilitates greater speed. It is not possible in some of the levels to deepen the canal by bottoming out; in those instances improvements should be accomplished by the raising of the banks. Where acqueducts and large culverts are found, it is economy to increase the water capacity by the raising of the banks. In some instances the raising of the banks on one level and the bottoming out on another might dispense with a lock which would also be desirable. It is my judgment that these improvements can be made with an expense to the state, not exceeding $4,000,000, and provide all of the waterway necessary for transportation of many times the present volume of business now secured to the canal.

As to the source of supply of electricity, it should be stated that the great hydraulic development at Niagara furnishes a medium through which all of the electricity required in canal propulsion can be obtained. It is entirely practical to divert power from tho various transformer stations to be erected by the Niagara Power Company throughout the state to a trolley system upon the canal; these transformer stations will be furnished with electricity at a high voltage from the Falls for local distribution, and it can be furnished to the state, or through some other medium, to the boatmen at a very moderate cost. This cheap power will add new life to the canal and inspire many an energetic, industrious and capable man to engage in the transportation of grain and merchandise upon that waterway. His only outlay is in the construction of a boat and consort equipped with an electric motor; from the trolley wires can be metered to him electricity for propulsion, for which he will be required to pay only a very small sum.

There is no point whatever in the claim that electricity would fail because of the inability of a motor boat to navigate the Hudson. Steam has been in competition with horse and mule power upon the Erie Canal for many years; the horse and the mule are ahead up to this time as statistics show. It cannot be claimed that a horse or mule boat has any better facilities for navigating the Hudson than a boat equipped with an electric motor. It is not practical for canal boats to navigate the Hudson; they are not river going boats; they traverse the Hudson now in fleets behind a powerful tug and not under their own steam subjected to the tides, currents, high winds and turbulent waters.

Opposition is always found to every new enterprise or departure from well-known methods, and opposition tends to develop practical and feasible systems. It is my judgment that the introduction of electricity upon the Erie Canal marks a new era in this great waterway which will ultimately inure to the benefit of everybody in the Empire State.

AN ELECTRIC TRACTION SYSTEM OF HAULING BOATS ON THE ERIE AND OTHER CANALS.

BY

Joseph Sachs.

THE electric motor has been substituted for other sources of energy with such great success in so many instances, that in the minds of those familiar with electrical matters there has been no question as to the successful operation of electrically propelled canal boats as has recently been proposed and experimentally tried, namely, the propulsion of the boat by a screw revolved by an electric motor located on the boat and receiving current from a suitable system of bare conductors by suitable flexible contact devices. There is nothing new or doubtful in the propulsion of a canal boat by a screw propeller, as such has been accomplished for years by the steam canal boat and there is no question as to the successful and more efficient substitution of the electric motor for the steam engine. But there are so many objections to a general adoption of a system of electric propellers that in the mind of the writer and many others familiar with the requirements, this method will not be the one ultimately adopted as a standard method of transportation on the canal.

There can be no question as to the successful operation of boats on the Erie and other canals by an electrical method or system, and such a system must fulfill the following requirements:

1. It must not in any way affect the present working of the canal.

2. It must not in any way affect the banks or general structure of the canal as the propeller would.

3. There should be no special motor equipment required on the boat which takes up room that may be used for paying freight and which can only be used where there is a system of electric transmission.

4. It should be sufficiently flexible to prevent the stoppage and stalling of a boat if its propelling power should be disabled.

5. The method of transmission of power should be such as not to be easily crippled.

6. The operation should be cheap and simple and appeal to the boatman as a better method than those in use at present.

The electric propeller system does not fill any of these conditions but would require a special motor equipment for every propelling boat which could only be used on the canal and would be dead weight which might be replaced by paying freight. If a motor is disabled the boat is stalled until proper repairs can be made. The use of a screw, whether propelled by electric or steam motor, if generally adopted, would in a short time destroy the present banks of the canal by the wash created, and there are sundry other objections. It has been said that the speed can be increased, but this is not a fact, as the electric boat can go no faster than the steamboat unless the canal is deepened, and the

writer thinks this a prime necessity for the adoption of any system to go at a higher speed.

The writer, has recently devised a system of hauling canal boats which he believes fulfills all of the above and other conditions, and which he and others consider a more feasible system of electrically operating canal boats. The primitive method of operation by *pulling from the shore* is adhered to, but for the faithful but slow and uneconomical animal is substituted an equally sure and faithful but more rapid and economical electro-mechanical mule. Along the berm bank of the canal are erected posts at a distance of about thirty feet apart. Upon the side of these posts and facing the canal are iron yokes which support rails running parallel with the canal, and which also support all necessary wires.

These rails are so arranged as to permit a so-called "hauler" to run in either direction and to permit the boats to pass one another. These haulers consist of a light frame work of metal held to the rail by suitable driving and gripping wheels. Fastened to the frame of the hauler and geared to the driving wheels is an electric motor which receives its current from suitable conductors fastened to the structure. The motor will be of the ordinary waterproof railway type, and the gearing and running parts will be automatically oiled and as the apparatus is entirely encased it will require hardly any attention. The boat in the water is attached to the hauler by any suitable connection and the motor is started, stopped, reversed and run in any direction by a regulator on the boat, but connected with the motor on the rail. By suitable gripping wheels and adjusting devices any amount of traction can be obtained and any number of driving wheels can be geared to the motor. The generating stations can be the same as for any other system of electric transmission and situated along the canal.

The writer thinks it is highly feasible to operate generators on a two-phase high voltage system having its central point at Niagara and reduced to about 500 volts, as used ordinarily for electric railroads, which would be the potential used by the hauling motors. This would make no material change in the construction of the line motor or necessary regulating devices from that in use on electric railways to-day. The two may be combined, as a division of the generating plant along the line would make the operation of the system less liable to interruption.

The speed obtained by this system can be varied to any extent within reasonable and necessary limits. It is a fact that, with a given boat at a certain speed, it will take less power to pull that boat by a direct pull than it would take to propel it by a screw propellor. Such being the case this method of hauling boats will allow of smaller motors, smaller central station capacity and smaller feeders, and the cost of operation would be less than the electrical screw propeller system, and it is reasonable to believe the cost of installation of such a system as perfected would be but slightly, if at all, in excess of the propeller system. Besides, the propeller system would necessitate the rebuilding of the banks of the canal if that method were generally adopted, which would necessitate the outlay of an immense amount of money.

The writer believes that the hauling method is the most feasible for general adoption on the canals and believes the above system to be particularly adapted to the needs of canal transportation in this State as the system also contemplates hauling a steam canal boat with, or without, consorts from Buffalo to Albany, from whence the steamer can proceed down the river with its own motor and only carry enough coal for such a trip, and thereby make a continuous system. The writer hopes shortly to give further details of his system.

TROLLEY ACCIDENTS.

BY G. C. F.

NOTING Mr. E. H. Johnson's request for methods of car control the following is submitted for what is worth:

The controller on the car is to be so arranged, by a friction cylinder or otherwise, that it can be turned both backward and forward from the "off" position, the backward motion to stop the car. The connections to be so made that motors, being driven by the momentum of the car, generate a current which is sent through electromagnetic brakes on the wheels, similar to those described in several communications to the ENGINEER as track brakes. The magnetic pull will apply the necessary force on the brakes, which can be also connected by means of a chain to an ordinary hand crank. The starting resistance can be used to change the amount of current and therefore the suddeness of the stop. As a last resort the last stop of the controller should reverse the motors, this being done with brakes off. This last change should be protected by an extra strong catch as it should never be used except in cases of extreme necessity.

The advantage of this method of control is that the wheels cannot skid and therefore the maximum amount of stopping energy can be applied.

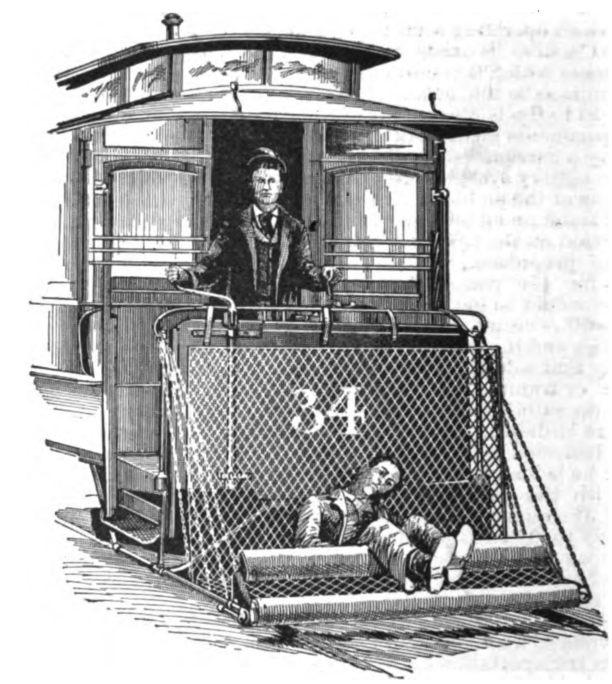
PLANS have been made at Geneva, N. Y., for putting on Seneca Lake an electric boat for commercial purposes. The boat is to be 150 feet long, 25 feet wide and 9 feet deep, with five feet draught. It will be driven by twin screws.

THE ROBINS LIFE GUARD.

AMONG the many devices recently brought forward to prevent accidents to pedestrians from collisions with street cars, whether operated electrically or by cable, probably none has been subjected to more severe tests to prove its efficiency than the life guard made by The Robins Life Guard and Manufacturing Co., of the Manhattan Building, Philadelphia.

The fender consists of an iron frame, bolted to the under part of the car body and extending in front of the car three feet six inches. The frame is made of one inch gas pipe, hinged in such a manner that it can be folded up when the car is reversed or stored, occupying a space of only ten inches. Wire netting covers the bottom and extends upwards at a right angle and in front of the car platform, about six inches from the dashboard, the horizontal portion of the netting and frame being six inches from the track or roadway. The wire netting is attached to the frame by springs, thus preventing a person caught up in the fender from receiving any undue shock or injury.

Across the front end of the fender there is an elastic steel frame covered with a rubber tube five inches in diameter. This is connected to the ends of the fender frame by two short springs, making a very elastic buffer; and, with this buffer a person standing on the track would first come in contact and, owing to its yielding nature and to the fact that there is nothing solid across the front end of the fender, (the end of the frame being practically open, as the cross bar is placed back eight inches from the outer end), the blow struck is a cushioned one. There is also a



THE ROBINS LIFE GUARD.

second rubber guard ten inches high, attached to the bottom netting eight inches from the front end of the fender. This guard has a spring-controlled rearward movement; and, when in position stands upright. Its object is to prevent a person from being thrown out of the fender after having been caught up.

The accompanying illustration is from a view of the device in actual operation in Brooklyn, Oct. 10. When the man was struck the car was moving at the rate of twelve miles an hour and the guard picked him up without doing him the slightest injury.

Similar tests have been made on several railroads, catching up between two hundred and fifty and three hundred adults and children of different ages, the cars running at speeds ranging from two to fifteen miles an hour; proving, it would seem, beyond the slightest doubt, its entire adaptability to the purpose intended.

STREET RAILWAY CONSOLIDATION IN INDIANA.

THE CITIZENS' STREET RAILROAD CO. and the Muncie Street Railway Co., of Muncie, Ind., were consolidated recently and the task of completing eight miles more of electric railroad line was begun about six weeks ago. When completed the new company, which is known as the "Citizens' Street Railway Co." will operate 15 miles of track with 25 cars.

The officers of the new company are: J. S. Tally, president; Geo. F. McCulloch, secretary; C. L. Miller, treasurer; W. C. Gotshall, general manager.

THE CANAL CONFERENCE.

ON December 5, delegates of the most important trade and labor organizations of the State of New York met in the rooms of the New York Board of Trade and Transportation for the purpose of discussing matters relative to the canals of the State with a view to improving their usefulness.

The conference was called to order by Mr. James H. Seymour, of New York, who referred to the recent experiments in the application of electricity on the canals and said that it seemed as if we had arrived at a point where this force could be employed to enhance the value of the canals. He cautioned the delegates against allowing the control of the power to get into the hands of the railroads.

Mr. Harvey J. Hurd, of Buffalo, on assuming the permanent chairmanship, recited in brief the history of the Erie canal for the last 20 years and impressed upon the members the necessity of thorough investigation before committing themselves to any plan of operation and especially warned them to guard the control of the electric power.

A letter was read from Governor Flower in which he referred to the recent experiments as a probable solution of the canal problem, but deprecated the granting of large appropriations for canal work. The letter raised a storm of discussion in which the speakers disagreed on nearly every point with the views expressed by the Governor. It seemed to be the general opinion that the deepening of the canals was an imperative necessity, and a letter from Mr. Horatio Seymour, ex-State-Engineer, to that effect was read and applauded.

A number of inventors and advocates of methods for applying electricity to canal boat propulsion were present during the conference some of whom asked for permission to address the members. Owing to the lack of time these requests could not be granted. A committee was appointed, however, to co-operate with the executive committee of the Canal Improvement Union at the approaching sessions of the Legislature, to whom also was referred the investigation of all proposed methods of propulsion by electric or other methods. This committee consists of the following gentlemen: M. M. Drake, Buffalo; Washington Winsor, New York; C. B. Nichols, Albany; Robert H. Cook, Whitehall; George T. Clark, Oswego; Wm. A. Sweet, Syracuse; J. M. Wiltsie, Pittsford; Daniel Spraker, Jr., Sprakers; L. B. Sherman, Rome; Harvey J. Hurd, Buffalo; Frank S. Gardner, New York; John A. Barry, Oswego; E. P. Newcomb, Whitehall.

ELECTRICAL PROPULSION FOR THE C. AND O. CANAL.

A SPECIAL dispatch from Baltimore of Dec. 7 says: A company in which Major Alexander Shaw and Charles K. Lord, third vice-president of the Baltimore and Ohio Railroad, and others are incorporators has been formed for the purpose of placing the trolley upon the Chesapeake and Ohio Canal. The success of the experiments upon the Erie Canal has led to this enterprise. It will probably be some time before the company gets to work, but its organization means that the work will be accomplished in good time.

The Chesapeake and Ohio Canal extends from Cumberland, Md., which is the main point for the Maryland and West Virginia bituminous coal trade, and extends to Georgetown, in the District of Columbia, where it reaches tidewater. The distance is 184 miles. It is important because of its value in the cheap transportation of soft coal. More than 4,000,000 tons are shipped from Cumberland annually. From Baltimore this coal is shipped to New York, to all parts of the New England coast, and to San Francisco. Recently a good paying trade in coke has been started with Mexico.

ELECTRICAL CANAL PROPULSION FOR PENNSYLVANIA.

THE SCHUYLKILL NAVIGATION COMPANY, operating the canal of that name, are considering the advisability of adopting the trolley system. The canal is about 100 miles long, and Professor Haupt, the well-known engineer, is quite sanguine that electric traction can be introduced with great advantage. His idea is to place the dynamo stations under the dams, where ample water supply would be found, utilizing the water now going to waste, and get the operating power for nothing.

Both the Lehigh Navigation Company and the Delaware and Hudson Canal Company are also thinking of applying the trolley system to their lines, and the Chesapeake and Delaware people are investigating the subject.

UNION OF BROOKLYN SURFACE RAILWAYS.

THE consolidation of the different railroad companies in Brooklyn will make a corporation with $54,000,000 stock. The plan was proposed at a meeting of the directors of the Long Island Traction Company recently held, and was adopted and indorsed by the Brooklyn Traction Company. In accordance with the plan the Brooklyn, Queens County and Suburban Company has been organized with a capital stock of $15,000,000, the company to continue for 100 years, and the Brooklyn City Railroad Company has already purchased the Flushing and College Point trolley railroad. The Brooklyn City tracks will be extended from Corona to Flushing and from Jamaica to Whitestone.

MORE DATA ON TRACTION EXPERIMENTS.

BY ELMER A. SPERRY.

SINCE compiling the paper on "Traction and Street Railway Trucks"[1] further experiments have been undertaken verifying fully the results given in the communication as presented at Milwaukee, and, in addition, other facts have been learned, one of which in particular may be of interest to your readers. Without going fully into the details of the experiments the results may be given as follows:

It has been discovered that the nature of the coupling from one axle to another determines the amount of useful effect appearing as draw bar pull as stated in the paper, but to a very much larger extent than was at first supposed.

The coupling from one axle to the other must be perfectly rigid and metallic; that is, no cushions or springs are allowable, in fact nothing should be used to couple the drivers which will yield or allow one driver to move even in the slightest unless the other is compelled to make a corresponding movement, whereby the shearing of the minute teeth is prevented, the interlocking of which teeth constitutes adhesion. The experiments emphasize a statement made in the paper to the effect that preventing the start to slip is the critical point, and that the harmony of motion of the drivers must be absolute; an approximate harmony is not sufficient for the purpose. The difference between a rigid connection and one which is of a yielding nature is very marked, the readings in drawbar pull taken with a yielding connection being almost as low as with independent motors. It is of interest to note, in this connection, the great wisdom exercised by locomotive builders in the form of connection which they have finally adopted as standard, and it has been suggested by one who witnessed the results of these experiments that they doubtless "wrought wiser than they knew." The latest series of these experiments to determine the relative value of connections between the axles wherein springs, cushions or other yielding medium was employed as a part on the one hand, and rigid connections on the other, has proved conclusively that for best, or even good, results in traction, the connection between the axles or wheels should be metallic and non-yielding; anything like a spring or cushion should be entirely eliminated therefrom. In view of the care exercised in these tests and the pronounced character of the results obtained, the last paragraph of my paper should be changed to read as follows:

"While working upon a level, and especially in damp weather with a slimy rail, almost the same advantage in traction will be found to exist as is here given for coupled wheels working on grades, provided always the mechanism used affords on the one hand a perfectly unyielding metallic coupling, while on the other it does not interfere in the least with the flexibility of the truck."

RAILWAY WORK IN CANADA.

THE STANDARD LIGHT & POWER CO., of Montreal, Canada, has sold its electric railway franchises for the towns of St. Cunegonde and St. Henri to the Montreal Street Railway Co. for $50,000, cash. By the terms of the sale, a portion of the railway is to be built immediately and the remainder is to be completed and in operation by July, 1894. The residents of these towns, which adjoin Montreal, are to be carried for a single fare over the system of the Montreal Street Railway Co. and are to have all the privileges of transfers and reduced rates for tickets enjoyed by the inhabitants of the city.

A POWER HOUSE WRECKED.

A DISASTROUS explosion of natural gas occurred on Nov. 29, at Elwood, Ind., wrecking the building of the Electric Street Railway Co. It seems that the natural-gas pipe leading to the boilers had leaked, and the gas, after accumulating under the floors, ignited. The city is in darkness and the cars are not running.

IN THE NECK.

WHO will gainsay the fact that the life of the manager of a electric plant is not without its pleasant episodes? As a sample of what helps to make such a life happy, we print below a communication recently received by a station manager in a Texas town:

MR. ——: If I come up, can you give me a shock of electricity? I have a stiff neck. MRS. ——.

The plant was not in operation at the time, but the testing magneto was sent her with full instructions as to its use.

1. THE ELECTRICAL ENGINEER, Nov. 1, page 391.

A NEW METHOD FOR AUTOMATICALLY STARTING AND PROTECTING ELECTRIC MOTORS.

BY G. H. WHITTINGHAM.

THERE is probably no electrical apparatus, outside of the dynamo and motor, upon which so much energy and inventive faculty has been expended as upon appliances used for starting, reversing and stopping the constant potential motor. Indeed were it not for such devices the field of the electric motor would be confined to a very small portion of the work it now daily performs. The rapid introduction of the electric street car has called for and developed a class of hand switches and controllers that meet the requirements of such work most admirably, but with the appearance of the direct electric elevator, the requirements and the means of meeting them change materially. The street car has a decided advantage over the electric elevator in many points concerning the controlling apparatus. In the first place the handling of the controller of the street car is entrusted to a competent man who is familar with the proper working of the switch; next, the weight of the car is such as to allow a wide latitude in the amount of current thrown on the motor when starting the car without causing it to jerk unpleasantly; and lastly in the case of accident, any part of the car is readily accessible for repairs.

In the direct electric elevator, however, we find none of these conditions. The running of an elevator is almost universally in the hands of a boy. The elevator car is balanced and very sensitive to variations of the starting current, and irregularities in handling the controller of the motor are disagreeably noticeable in the movement of the car. Finally the blowing of a fuse or forcing the motor beyond its capacity usually results in imprisoning the passengers in the elevator well until some outside assistance reaches them. Evidently perpendicular transit by electricity was ripe for the introduction of some form of automatic starter and controller which contained none of the acknowledged defects of the hand controller and which would prevent the occurrence of any of the above mentioned difficulties. The pressing need developed a few original devices which started the motor automatically but which were not automatic in returning to the safety position upon the cessation of the current. These devices were brought out in 1889 by the Automatic Switch Company, of Baltimore, Md., and were followed in 1891 by the introduction of a solenoid motor starter which was automatic both in starting and stopping, being actuated entirely by the current. These starters have been much imitated and they form the controlling principle of most of the direct electric elevators on the market to-day. With the experience gained from the construction and operation of these earlier forms of starters, the Automatic Switch Company has developed, patented and put upon the market an automatic reversible starter for elevator work which is as much in advance of the solenoid and dash-pot starters, as the latter were ahead of the hand controllers.

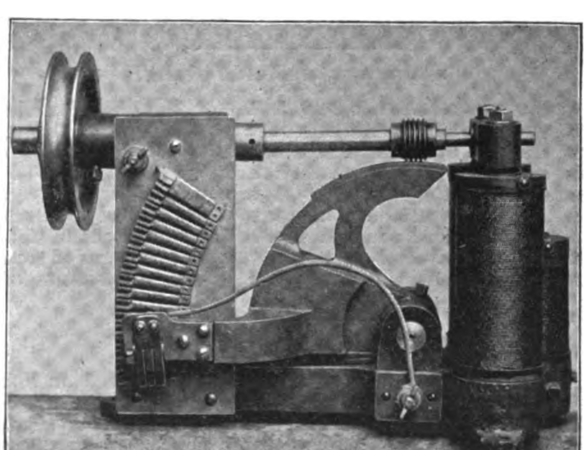


FIG. 1.

The accompanying engravings illustrate both the automatic reversible starter and a new automatic non-reversible starter for pumping and pressure tank work, the mechanism of which is a radical departure from all existing devices for the automatic handling of electric motors, in that it takes from the motor at the time of starting the requisite amount of power to move the resistanc econtroller, thus overcoming the greatest difficulty met in the operation of dash-pot and magnetic controllers, viz., lack of positive movement. By referring to the engraving, Fig. 1, it will be noticed that the mechanism of the reversible starter consists of a pawl and ratchet operated by an eccentric. The eccentric is driven either by direct connection to the armature shaft of the motor to be started, or as is shown, the shaft of the starter may carry a pulley to which a belt is run from a small pulley on the commutator end of the armature shaft. The magnets of the starter are energized by the same current which starts the motor, and at the same instant cause the pawl and ratchet to engage a series of teeth which form part of the lever controlling the resistance of the starter, thereby applying to this lever for its operation power from the motor during the time of starting. The lever has only a

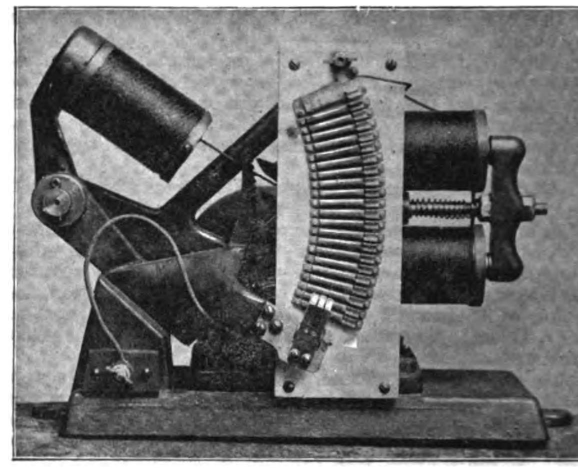


FIG. 2.

sufficient number of teeth to cause it to be moved over the resistance contacts and the pawl merely works free after all the resistance is cut out, while the ratchet retains the lever in this position during the run of the motor. Interruption of the current from any cause immediately releases the pawl and ratchet, and the lever falls by its own weight to the point of greatest resistance, ready to start the motor with the return of the current.

The illustration, Fig. 2, shows a non-reversible starter for use in connection with motors running only in one direction and it differs from the reversible starter in that it is operated by a worm controlled by magnets connected in the motor circuit, the worm being driven by the motor or any suitable power. It will be readily understood that starters of the construction illustrated in this article operate with a certainty and power hitherto unknown, and that they are capable of handling motors of any horse power is apparent from the fact that there need be no limit to the size of the contacts carrying the starting current. A motor-controlled starter becomes so much a part of the motor itself as to afford protection against mismanagement of any kind. It invariably moves as the motor moves and exactly in accordance with the capability of the motor to receive the starting current. This feature is particularly valuable in connection with electric elevator work as it renders it impossible for the motor to be started under an overload; it also prevents current being forced upon the motor before the fields are fully saturated and in condition to do full work.

TO LICENSE ELECTRICIANS.

THE NEW YORK BOARD OF FIRE UNDERWRITERS have passed a resolution asking Gov. Flower to have a law passed requiring persons desiring to do electric light wiring to pass an examination and to get a license just as engineers have to.

PERSONAL.

MR. JAMES SWINBURNE.

MR. JAMES SWINBURNE has ceased to be electrical editor of *Industries and Iron*, but our English contemporary will still, we are glad to learn, be able to count him as a contributor.

MR. F. BATHURST.

MR. F. BATHURST, of the General Electric Co.'s engineering staff at Schenectady has been suddenly summoned home to England on account of illness in his family, and left on the "Majestic" on Wednesday for Liverpool.

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INCANDESCENT LAMP ECONOMICS.

THE announcement of the reduction in the price of incandescent lamps on the part of the General Electric Company, which appeared exclusively in THE ENGINEER of last week, has created much comment in electric lighting circles. Coming as it does so soon after a long series of legal fights with occasional victories which have given the General Company unquestioned advantages, it is worthy of special attention as indicating the inauguration of a policy which we cannot but believe will inure to the benefit of the lamp consumers as well as to that of the company, and indeed the entire industry. The circular just issued places the price of the lamps from 10 to 24 candle-power at 65 cents, list. From this price a discount of 50 per cent., will be allowed on packages of 200 up to 1,000; from 1,000 to 2,000 an extra 5 per cent., and on 2,000 and above, an extra 10 per cent. will be allowed. To the small consumer, therefore, the lamp will cost 32½ cents, while the large customer will be able to secure lamps at the rate of 29¼ cents each. Whether the recent expiration of the English Edison patent was a determining factor in the present step, or not, the fact appears significant that the cut in price is almost coincident with a large reduction of price in England where lamps are now generally quoted at 1s. 6d. (36 cents) and even as low as 1s. 3d. (30 cents), with a liberal discount to the trade. Whatever may be the bearing of the patent question on the present lowering of price, the step taken by the General Company is probably one of much deeper import than would at first appear. It cannot have escaped the attention of the General Company, and they were probably led by this consideration, among others, that the surest way to increase the demand for lamps is to encourage the consumer to renew lamps as soon as they show any marked diminution in candle-power. For, notwithstanding all that has been said and written to demonstrate the false economy of allowing lamps to attain a decrepit old age, it remains true that the average consumer has in the past felt that with the ruling price of lamps, economy still lay on the side of low efficiency and long life, and no amount of argument, either on the part of the traveling salesman or by reference to published papers on the subject, has succeeded in convincing him to the contrary. Nor is this feeling entirely without justification when we remember that an indispensable factor in the successful use of a high economy lamp is *regulation.* It is generally admitted that there is nothing to be gained in operating lamps at so high an economy as 3.1 watts per candle where the variation of pressure on the mains exceeds 2 per cent. from the normal; and since such regulation requires the most careful attention in distribution and at the central station, it is safe to say that but a small percentage of stations now in operation could operate such lamps to advantage at their old higher price. The lower cost of lamps therefore will bring a larger number of stations within the category of those who can now afford to use a higher economy lamp even with more frequent renewals, and who will thus be the gainers on the side of the expense for generating current; while on the other hand the greater satisfaction given to the customer will still further increase the demand for lamps and current and hence increase the revenue of stations.

But there appears to be a broader aspect still to this reduction in the price of lamps which, we may add, may probably be considered to be only the forerunner of still further reductions in other lines. There are not a few who have long held that the true business of the electric central stations is the manufacture and sale of current—and current only, and that when the current is delivered at the socket the function of the electric company ought properly to cease. As applied to lighting this means that the consumer ought to be at liberty, in fact, required, to furnish his own lamps, procured from whatever source is most advantageous to him. That this idea of making the central station a purveyor of current only is not merely a speculative one is shown by the fact that in San Francisco, for instance, the local Edison company is actually selling lamps at 5 cents below cost in order to encourage the liberal use of current. In this instance the company furnishing current happen also to be sellers of the lamps, but they would obviously be glad to be relieved of this burden.

And this brings us one step nearer to the time when incandescent lamps will form part of the regular stock of every grocery and hardware shop to which the consumer can direct his steps when in need of a new lamp, just as he now does when he needs an oil lamp chimney or cotton wick. We cannot but believe that the decisive step towards "popularizing" the incandescent lamp, inaugurated by the General Company, will have a most salutary and stimulating effect upon the entire industry. Cheaper lamps means more lamps; more lamps means more current; more current means more dynamos, engines, boilers, and the thousand and one things which go to make up the equipment of the central station as well as the local building outfit. The wisdom of the course adopted by the General Electric Company seems unquestioned, although it is worth recalling that when Mr. Samuel Insull, then directing affairs, made this step a part of his broad and energetic programme, the internal objection and criticism was so strong that he had practically to abandon it against his will and conviction. Times change.

MISCELLANEOUS.

AN INNOVATION IN REDUCTION GEARINGS.

BY

H. A. Wellman.

In their admirable article on "The Sprague-Pratt High Duty Electric Elevator," in THE ELECTRICAL ENGINEER of Nov. 2, 1892, the writers say of their competitor, the worm gear elevator, that "it was discarded for general high speed service ten years ago, as soon as the hydraulic set the pace at 300 feet per minute and over," and that, "nothing can prove the limitations of the worm gear elevator more clearly, than the simple fact that, costing less than two-thirds as much to build as the hydraulic, half as much to run and occupying about one-sixth the floor space, it has never been used for high speed service. Several of the leading elevator companies of this country, which have built these elevators for thirty years have spent unlimited skill and money trying to make a worm gear elevator to do the work of a hydraulic, and to be accepted for such work, and thereby command a higher price for that which cost them less to build."

Why this is so, they do not state, but to one familiar with this class of gearing, it is evident that it must be due to the great friction inherent to it. It is the writer's aim in this article to describe a worm gearing without friction, and in which the well-known anti-friction ball bearing is used.

The application of "ball bearings" to a screw system is far from new, for if we search through the records of the Patent Office, we find that as early as Oct. 13, 1874, a patent, No. 155,862 was issued to Cyrus W. Crenshaw, of Athens, Ala., for an "Improvement in Screw Presses," and in which the one claim is as follows: "The combination with a screw A, B, of the spirally grooved nut C, return channel E, and continuous line of balls G, as and for the purpose set forth." And to this obscure inventor, who, twenty years ago, conceived all the essential elements, should be given the honor of inventing the ball bearing screw and nut, for, if we also examine the subsequent patents of Lieb, No. 438,320, Pratt, No. 448,788 and 476,304, and Brunthaver, No. 477,-642, we find that they are for improvements in details only, and could not be placed in independent use but for the expiration of the Crenshaw patent.

Having thus shown the state of the art regarding ball bearing screw systems, I will describe a radical departure, a ball bearing worm gearing, of multitudinous applications, and standing apart in the field of mechanism.

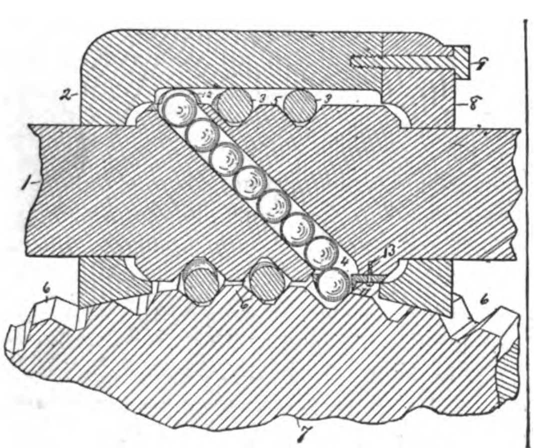


FIG. 1.

Fig. 1 is taken from my patent No. 506,409, of Oct. 10, 1893, and in describing the same I will quote from the specification as follows: 1 indicates the shaft, 2 the bearing or casing therefor, and 3 the balls. The shaft may be journaled in bearings or casing in any desired manner and is provided with a channel or by-pass 4, through which the balls are returned to any desired part of the worm, or threads, after having engaged with the teeth 6, of the wheel 7, which is to be driven or operated. The channel 4, has its ends or openings on different sides of the shaft, and is preferably made diagonally through the shaft, but it may be curved to a greater or less extent, or even made substantially axial.

The casing is provided with a head or cap 8, which is secured thereto in any ordinary manner, as by bolts 9, or there may be a head at each end, and one side of the casing is provided with a slot or channel 10, through which the edge of the wheel projects far enough to be engaged by the balls. The bore of the casing is substantially smooth and cylindrical and so much larger than the shaft that the balls, as they move around with the shaft, bear against the interior of the casing and are prevented from getting out of their proper position.

As the casing and shaft are longitudinally stationary relatively to each other the balls must move longitudinally of the casing the distance of the pitch of the screw for every revolution they make of the shaft, and as they do not necessarily travel this distance for every revolution of the shaft, it is evident that they do not always travel around the casing in the same path. Hence it is absolutely necessary that the inside of the casing be substantially cylindrical, except at the slot, at which point the edge of the wheel or other

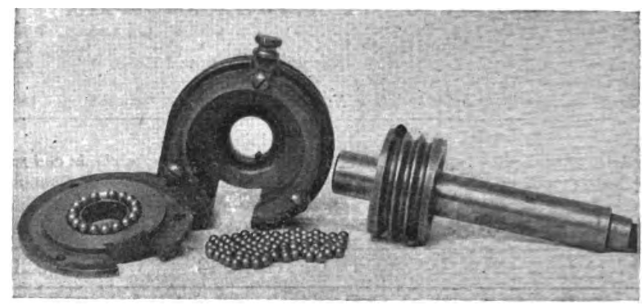


FIG. 2.

movable part enters and completes the cylindrical form of the bore, and holds the balls in position.

By joining the ends of the spiral groove between the threads by the by-pass, a continuous channel or path is made for the balls so that they can be made to pass from one end of the spiral groove to the other, whichever way the shaft is rotated, thus permitting the shaft to be run in either direction according to which way it is desired to rotate the wheel.

When the balls reach the end of the spiral groove, it is necessary to provide some means for forcing them into the by-pass and prevent them from being caught between the shaft and the interior of the casing at the end of the groove. I prefer to do this by means of these hoods 11, which fit over the union of the by-pass and the spiral groove, one at each end, each hood being provided with a semi-circular groove or channel 12, upon its under side through which the balls pass from the groove to the by-pass. The top of this hood is of such a height as to pass around within the bore of the casing, and also through the teeth of the wheel without touching. Fig. 2 is taken from a photograph of a gearing now in operation, and possesses additional features not described in the above.

The many applications of the worm gearing are too well known to need extended comment; it is used on all the leading electrical elevators, with the exception of the one mentioned at the beginning of this article; it is used on chain falls in nearly every shop in the country; it is used in the Navy to manipulate large guns, and in a hundred other capacities, while an almost forgotten application is as a reduction gearing for electric car equipments.

Ever since the first attempts at the application of electric motors to car propulsion, inventors have appreciated the fact that in this lay the realization of an ideal gearing, and why this is so may be readily shown, it resting entirely upon the ratio which, at the present state of the art, must exist between the speeds of the armature and car axles, due to the comparatively high speed of the armature of a motor having a minimum weight per horse power. Considering the two extreme types of railway motors, viz., the double reduction, and the gearless, we find that the former is the most economical electrically, and has the smaller weight per horse power, due to the higher armature speed, but with a lower mechanical efficiency owing to the double train of gearing; while on the other hand the latter is the most efficient mechanically, due to the absence of gearing, but with a lower electrical efficiency, and of greater weight per horse power, owing to the exceedingly low armature speed necessary to conform with that on the car axles, and having the far lesser torque. As a compromise was evolved the "S. R. G." type, the standard of to-day, with a fair electrical and mechanical efficiency, and of reasonable weight per horse power.

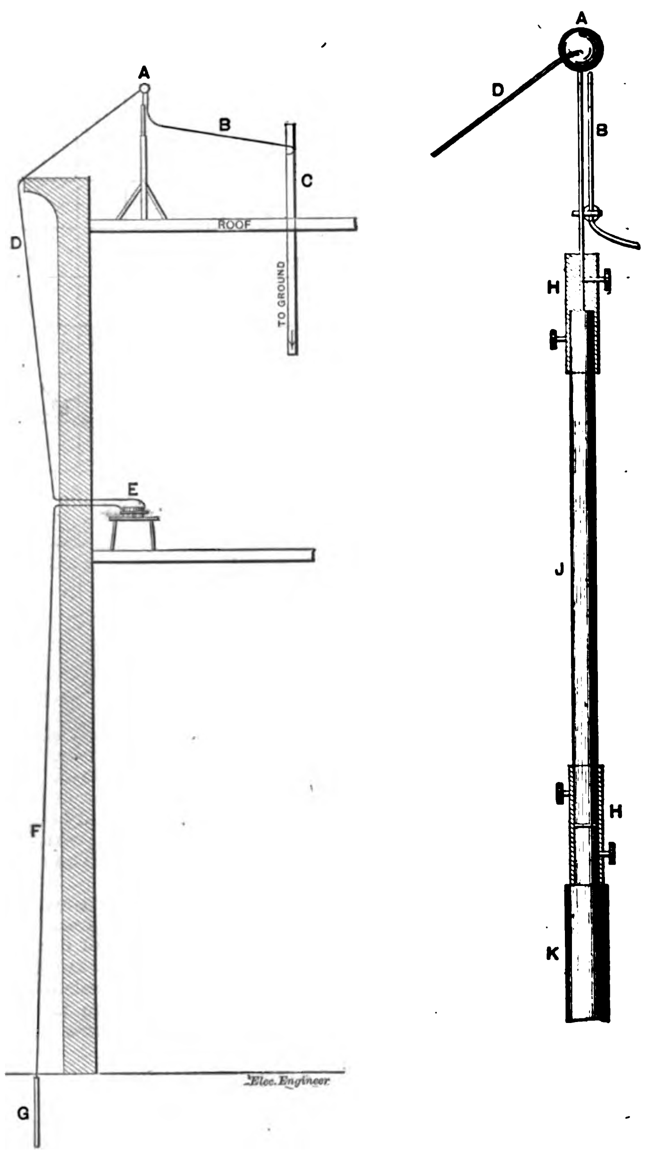
But in the worm gearing, as before stated, inventors saw the perfect gearing, for it would allow a high armature speed, with great torque; but to attempt to use the ordinary type for this work was out of the question, not only because of the high friction loss, and short life for even low pitches, but because of the high pitch necessary to give even the reduction required; and further, because the pitch must be great enough to allow the *gear* to drive

the *worm*, as would be necessary when running down grade, and with the current shut off; such requirements, it is evident, can only be filled by an anti-friction gearing, and having this, there is opened a new field in railway practice.

But in considering this field, broad as it is, the elevator field should not be forgotten, for surely Messrs. Sprague and Pratt would not credit their one rival with the remarkable strong points that they do, if these points did not unquestionably exist, and if they themselves did not feel convinced that the friction factor of the ordinary worm gearing debarred its ever becoming of importance in the elevator field.

THE OPPERMAN MAGNETO ELECTROMETER.

An arrangement for determining the electrical state of the atmosphere and foretelling the approach of storms, has recently



The Opperman Magneto Electrometer.

been perfected by Mr. J. Opperman, of St. Louis, Mo., and is shown in the accompanying illustrations.

Mr. Opperman's arrangement consists of a galvanometer interposed in a conductor which terminates at one end in a collector in air and at the other end, in the ground. The movement of the magnetic needle will, with a few exceptions, indicate a continuous current of electricity passing from air to earth and the extent and intensity of this current, according to the inventor, bears a significant relation to storms and other meteorological disturbances.

In the illustrations, the supporting staff K, glass insulating rod J, and stem of the copper collector ball A, are united into one piece by the clamps H H—the whole resting upon the roof of a building, as shown. One end of the conductor D is soldered to the ball A while the other end is passed through the window sill and made fast to one of the binding screws of a galvanometer at E. A similar conductor F is secured at its upper end to the other binding screw of the galvanometer and its lower end is soldered to a wrought iron rod about seven feet long, driven full length into the ground. B is a ⅜-inch copper wire having one of its ends soldered to a vent pipe of the building which extends to ground, while the other end, by means of clamp insulated from the stem of the collector ball, is firmly held in close proximity to, but not allowed to touch, this ball. This latter arrangement is designed exclusively as a safeguard against an overcharge of electricity, in case of a thunder-storm, and to lead any such charge silently and harmlessly to earth.

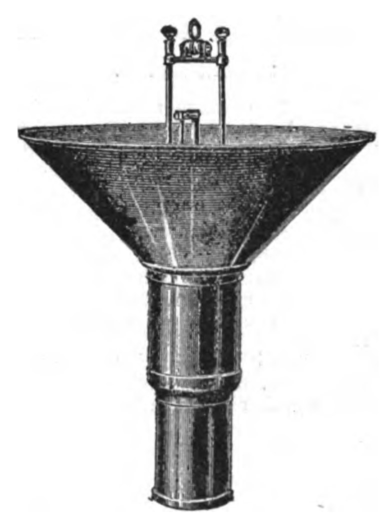
It will be seen that any current of electricity passing from air to earth, or from earth to air through the medium of conductors D, F, must pass through the galvanometer at E, since these conductors are insulated from the building, and that the magnetic needle will be caused to deflect and vibrate according to its extent or intensity. The galvanometer may be replaced by a voltmeter, ammeter, or other measuring instrument adapted to very low potential. In Mr. Opperman's experiments the vibrations ranged between 25 and 40 degrees during apparently normal weather, while the approach of a severe storm would be heralded from three to five days ahead by violent deflections of the needle while the sky was perfectly clear and the atmospheric conditions seemingly unchanged. An important feature of the device is that it can be used on the masts of ships at sea as readily as on buildings.

The United States Coast and Geodetic Survey and the Weather Bureau, we are informed, are examining this arrangement with a view to its adoption by the Government.

THE INVERTED ARC LAMP FOR INTERIOR LIGHTING.[1]

BY BENJAMIN A. DOBSON.

Some years ago, while engaged in visiting and examining certain mills on the Continent, the writer was much struck with a mode of lighting which he then saw for the first time. This con-



The Inverted Arc Lamp.

sisted in the use of electric arc lamps of from 1,600 to 2,000 c. p., suspended in a white enameled reflector at a certain distance below the whitewashed ceiling of the mill. The first he saw was of 2,000 c. p., and thoroughly lighted a room of about 40 ft. square with light sufficient to see to pick up a pin off the floor. The walls of the room, as well as the ceiling, were whitewashed. The light had a sort of bluish tinge, and looked like bright moonlight, but with much greater illumination and entirely without shadows. This appeared so striking that he made a few experiments at once, and found that it was possible to see into the interior of the machines, and even underneath them, in a way that up to then would seem incredible; and further, that it was not possible to make a shadow of any description, even when holding a hat only 2 in. above the floor; all that could be seen in the centre of the covered part was a comparatively slight deepening of the shade. In other departments of the factory he found the same plan equally effective, and the diffusion of light so complete as to be astonishing.

A number of experiments were then made by the author in various factories and especially in cotton mills to test the efficacy of such a system applied to a larger field of usefulness. The lamp used is shown in the accompanying illustration. It is made by

1. From "The Artificial Lighting of Workshops," London *Electrician*, October 27 and Nov. 3, 1893.

the Compagnie Internationale d'Electricité and known as the Pieper inverted arc lamp. The complete absence of danger will at once be appreciated.

It consists of two carbons of different diameters, the upper or negative carbon being solid, and the lower or positive carbon being annular and rather larger in diameter. Their areas are 0.200 square inch and 0.486 square inch respectively, which proportion ensures their both consuming at the same speed, thereby avoiding the necessity of any complicated clockwork arrangement to differentiate the speed of the feed. In this lamp there is no clockwork, but the carbons are drawn together by a pulley, string, and counterweight, their distance apart being regulated in the usual way by a magnetic brake. The pulley, weight and brake are all contained in a cylindrical box attached to the underside of the cone of the reflector; and the only interruption to the light above is that occasioned by the thin arms forming the clip which holds the upper carbon. The crater carbon is here the lower one, in order that the larger number of rays produced may be thrown upwards.

The practical results obtained by the author seem to show the success of the system. Inverted arc lighting has now been in use in some portions of his works for 12 and 13 hours a day during the last 12 months, and sometimes almost night and day; and the results of its working he has every reason to believe may be considered successful. Four inverted arc lamps were tried by Mr. John A. F. Aspinall in one of the Lancashire and Yorkshire Railway workshops at Horwich, in the large drawing offices, and the light for drawing purposes is as perfect a light as can be desired.

This has proved thus in practice to fulfill the requirements of a good artificial light for almost any class of manufacture. For bleach and dye works, where it is necessary to distinguish minute differences in shades of color, it must be invaluable, permitting this delicate work to be carried on in the dull winter days, which is now difficult if not impossible. If the insurance companies can be persuaded that not only is there no danger from this light, but that it is, perhaps safer than any other mode of lighting, there seems every possibility that the use of the arc lamp will undergo a rapid development.

DYNAMO AND MOTOR TESTS.[1]

BY MAX MAYER.

The usual and most frequent method of testing dynamos and motors is by means of a Prony brake or some form of dynamometer. These methods are undoubtedly very good, but are difficult to carry on, requiring a machine of the same size as the one to be tested to supply the requisite power, and they sometimes lack the accuracy that is required. A simple, quick and accurate method which only requires a small dynamo to furnish the current is due to Mr. James Swinburne, the well-known English electrician. The losses in the conductors of field and armatures are determined by measuring the resistance very accurately and by multiplying by the square of the current flowing through same we obtain the energy wasted in watts.

The "stray power" as it is called, is made up of losses due to eddy currents, hysteresis, brush and bearing friction. These losses are measured together by running the machine as a motor

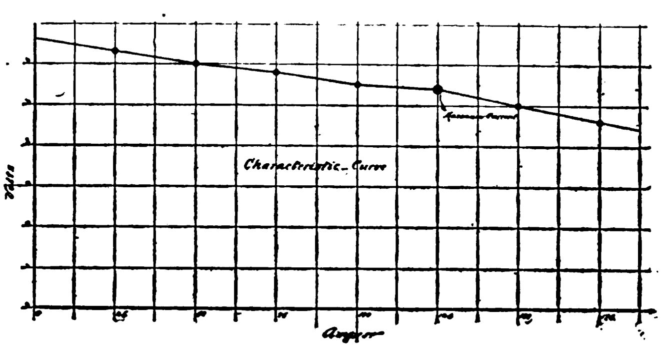


FIG. 1.

without any load, current being supplied from a small dynamo. The field of the machine must be separately excited so that the armature has the same magnetic induction as when running at full load; the electromotive force supplied to the armature is so adjusted as to run the motor at its proper speed. By measuring the current in the armature and multiplying this by the electromotive force supplied to the same, we obtain the losses in armature due to eddy currents, hysteresis, bearing and brush friction; adding to this the losses in field and armature due to ohmic resistance, the efficiency can easily be determined. The separate losses can readily be obtained by driving another machine of exactly the same size and construction with this motor. If the brushes of the second machine are off and the field not excited the motor will draw just that much more current as is required to overcome the bearing friction.

This difference in amperage multiplied by the voltage at the motor terminal will give the power wasted in watts due to bearing friction. By letting the brushes bear on the commutator, with field not excited, we can calculate the loss due to brush friction, and by

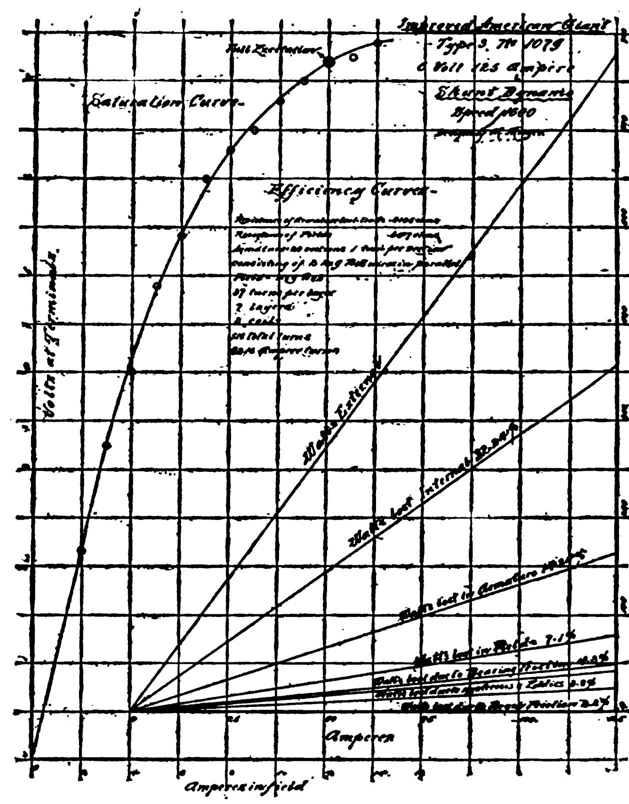


FIG. 2.

running the machine with brushes on and field separately excited, we can obtain the loss due to eddy currents and hysteresis.

There is also a method of separating the losses due to eddy currents and hysteresis by running the machine at different speeds by supplying the same with different voltage. The eddy current losses are proportional to the square of the speed, while the hysteresis losses are simply proportional to the speed. The results are obtained by plotting a curve.

The following data give the results of a test made by the author on a 6 volt, 125 ampere dynamo of his design. The results are shown by the curves, Figs. 1 and 2. The resistances of field and armature were measured after the machine had been running and acquired its normal heat so as to obtain the actual resistance as accurately as possible. The resistance of the leads are included in armature resistance as there may also be a slight loss due to that cause.

Test No. 1.—Dynamo running as motor.

Amperes in field	12
Amperes in armature	19
Speed	1600

Energy lost in watts due to eddy currents, hysteresis, friction.

19 Amperes.
6 Volts.
114 Watts.

Test No. 2.—Dynamo running as motor driving another machine of same size; brushes off, field not excited.

Volts, 6.
Amperes, 27.

27 amperes, is 8 amperes more than the previous 19 amperes; substracting this 8 amperes from 19 amperes leaves 11 amperes, which consists of brush friction, hysteresis and eddy currents combined.

Thus making a loss of

8 Amperes.
6 Volts.
48 watts due to bearing friction.

1. A Lecture delivered before the Franklin Electrical Society, New York, Oct. 1, 1893.

Test No. 3.—Same as before, brushes bearing on commutator in second machine, field not excited.

Volts, 6.
Amperes, 31.

This 31 amperes is 4 amperes more than 27 amperes. Therefore,

6 Volts.
4 Amperes.

24 Watts loss due to brush friction.

Test No. 4.—Same as before; field separately excited.

Volts, 6.
Amperes, 38.

This 38 amperes is 7 amperes more than 31 amperes. Therefore,

7 Amperes.
6 Volts.

42 Watts-loss due to eddy currents and hysteresis.

Test No. 5. Energy lost in armature due to ohmic resistance.

Amperes, 38
Volt Drop, 0.4

$\frac{0.4}{38} = 0.0105$ ohm = Resistance of armature including leads.

Loss at full load $C^2 R = 125^2 \times 0.0105 = 164.06$ watts.
164.06 watts lost in armature due to ohmic resistance.

Test No. 6. Energy lost in field due to ohmic resistance.

Amperes, 11.5
Volts Drop, 6.3

$\frac{6.3}{11.5} = 0.547$ ohms = resistance of field.

$C^2 R = 12^2 \times 0.547 = 78.761$ watts wasted in field due to ohmic resistance.

Total losses in Dynamo

164.06	watts in	Armature.
78.76	" "	Field.
48.00	" "	Bearing Friction.
42.00	" "	Hysteresis, Eddies.
24.00	" "	Brush Friction.

Total, 356.82 watts.

Commercial efficiency of Dynamo:

125 Amperes.
6 Volts.

750 Watts, external.
356.82 Watts, internal.
1106.82 Watts, total generated.

$\frac{750}{1106.8} = 67.76\%$ commercial efficiency.

The following is the result of a test of a 6 volt, 350 ampere dynamo, also designed by the author.

Total loss in Dynamo:

239.25 watts, Stray Power.
106.51 " Armature.
62.81 " Fields.

Total 408.68 Watts.
350 Amperes.
5.55 Volts.

1925.00 watts externally available.
408.68 " wasted internally.

2333.68 watts.

$\frac{1925.}{2333.6} = 82.49\%$ commercial efficiency.

THE CALIFORNIA MIDWINTER EXPOSITION.

The California Midwinter Exposition is being rapidly pushed to completion. Mr. W. F. C. Hasson, the electrical engineer in charge, has had his forces at work night and day, and we are now able to publish the following rules governing the supply of lighting and power, for the information of exhibitors and concessionaires at the Exposition:

All wiring must be suitable for the class of current the Exposition is able to furnish. Lamps may be supplied with a current from 100-volt A. C. circuit, 500-volt D. C. circuit lamps in series, and a limited number from 100-volt D. C. circuit.

Information concerning the class of circuit for any location may be obtained from the electrical engineer.

Current for arc lamps will be furnished at the rate of $65 per lamp of 2,000 nominal candle-power, from the opening of the Exposition, January, to its close, for a period not to exceed six months.

Consumers of light will be charged the actual cost of installation of arc lights and for all breakages. The Exposition will furnish carbons and service.

Incandescent lamp service will be furnished for the period of the Exposition at the rate of $8 per 16 candle-power lamp, this is to include the first lamp. Renewals and breakages must be furnished by the consumer. The consumer will furnish all fixtures and shades for the wiring of lamps.

Special agreement must be made for colored or fancy lamps, or lamps of other than 16 candle-power. Special discount will be made for service for installations of fifty or more lamps.

Power for motors will be furnished at the following rates for the period of the Exposition:

For one-fourth horse-power and less	$15 00
For more than one-fourth horse-power, and not exceeding one-half horse-power	30 00
For more than one-half horse-power, and not exceeding one horse-power	50 00
For more than one horse-power, and not exceeding two horse-power (per horse power)	45 00
For more than two horse-power, and not exceeding three horse-power (per horse-power)	42 50
For more than three horse-power (per horse-power)	40 00

A limited amount of power may be furnished to exhibitors free of charge to simply turn over otherwise inoperative exhibits, exhibitors to furnish all necessary motors, rheostats, switches, belts, countershafting, wiring, etc., necessary for connecting motors with main wires and operating machinery.

Motors must be suitable for operation of class of circuit furnished in exhibitors' location. All rheostats must be constructed wholly of non-combustible material.

SIEMENS & HALSKE'S METHOD FOR INCREASING SUBMARINE CABLE SPEED.[1]

It is known that the speed of transmission on submarine lines diminishes, for the same section, in the ratio of the square of their length. It can be increased by increasing the section of

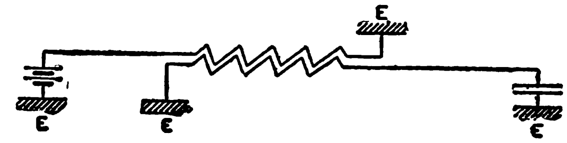


Fig. 1.

the conductor and by increasing the insulating covering of the cable, but the expense would be too large; thus a practical limit is put upon the length of submarine cables, beyond which it is no longer advantageous to go. The obviation of this inconvenience has been attempted by forming a conductor with two copper bands running parallel, the whole forming a condenser when these bands are insulated from each other as well as from the water. If these bands are divided into sections insulated from each other, and if they are placed in such a manner that the section points of one of the conducting bands will be in the middle of the opposite band, a series of condensers will be obtained, one armature of which will belong to the preceding conductor and the other to the one following. If one of the terminal condensers is charged by attaching a battery to one of the poles all the following condensers are also charged and the current thus freed on the outside armature can be utilized for signals. Such an arrangement is not practicable with the small differences of potential which have to be used.

The idea conceived by Messrs. Siemens and Halske differs from the above method and permits the length of the cable to be increased in ratio of 3 to 2, with the same facility of transmission.

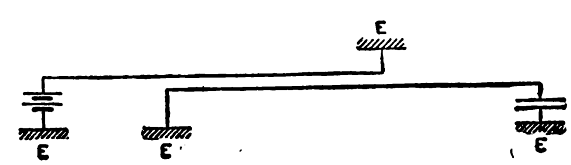


Fig. 2.

This result can be obtained by means of electromagnetic transmitting stations, which method has already been successfully employed for a long time on a submarine cable between Suez and Aden. The method, though not new in theory, is to replace the relay by an induction coil of proper shape.

The cable is cut in the middle and each of its extremities is connected to the two ends of the induction coil; the other two free extremities of the cable and of the induction coil are earthed.

Fig. 1 represents the system diagrammatically. The cable thus cut forms two separate circuits acting upon each other through induction and consequently each impulse of the current coming from shore stations is received at the other end with corresponding intensity. As each separate circuit comprises only half the length of the line, the working is theoretically increased in the ratio of 4 to 1. On account of the resistance of instruments, the increase of the length of the line by the induction coil and the return of the induced current, the facility of transmission is reduced almost one-half.

The practical realization of the introduction of the induction coil in the cable can be obtained as follows: Toward the middle

1. "F. G." in *La Lumière Electrique.*

of a given distance, the cable is cut, the cable being composed of two copper wires insulated from each other, which can be used symmetrically; the opposite ends of this double conductor are then connected to the cable in such a manner that each conductor forms the end of a circuit. This is illustrated in Fig. 2. The double core acts as an induction coil inasmuch as each of its copper wires takes the place of the helices in an induction coil. The iron armature around the cable strengthens the induction. The free ends of the double wire are earthed or connected to the iron armature of the cable. This arrangement may easily be established so that the cable can be submerged without danger to its laying or working.

Instead of dividing the cable into two parts, it can be divided into a larger number. At each cut can be inserted induction apparatus or double cables, as stated above. This method is particularly recommended when the cable is to be used for telephoning purposes. In certain cases the whole length of the cable can

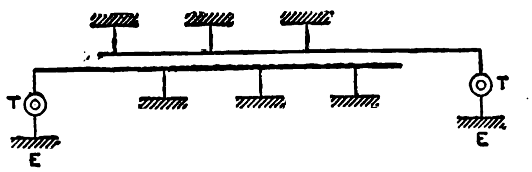


FIG. 3.

contain two conductors; each of these can then be earthed alternately at equal distances (Fig. 3.) This method is also especially applicable to underground telephone cables.

LITERATURE.

Continuous Current Dynamos and Motors. By Frank P. Cox, B. S., New York, *W. J. Johnston Co., Ltd.* 1893. 266 pages, 5 x 7 inches. Price, $2.00.

Now that the theory of the dynamo is thoroughly well established and a large variety of machines has been actually carried out in practice, there is now afforded excellent opportunity of fortifying that theory and modifying it according to the dictates of the best results obtained. The work before us is intended to furnish to the student an easy and logical way of applying the theory enunciated by Hopkinson and simplified by Kapp.

The author introduces the subject with some short chapters on the absolute system of measurement, with special reference to the magnetic units which occupy such an important place in the work in hand. Passing then to the classification of machines and the general principles of the magnetic circuit he takes up the theory of windings, losses, and the specific design of armatures and field magnets. Throughout this part of the work the student is aided by the numerical calculations of actual examples, in which we cannot help discerning how, in spite of the dictates of theory, actual practice compels a modification; and indeed the author himself recognizes this fact when he says that "we must be governed by experience and the study of the proportions of some dynamo of similar capacity which is known to give satisfactory results." We do not mention this as in any way a reflection on the work of the author or the methods pursued by him in elucidation of his subject, but merely to point out that theory combined with practice can alone give the most satisfactory results, here as well as in every other field of applied science.

The author then passes to the methods of testing the efficiency of motors and dynamos, including the obtaining of the characteristic curve, speed curve, potential curve and the losses. He has also added a couple of chapters on the testing of the complete plant, consisting of boiler, engine and dynamo. In this part of the work we notice that the author determines the efficiency of the engine by two methods. First, he gives theoretical efficiency, or fluid efficiency of the steam, that is, the ratio of the absolute temperatures of the steam at admission and exhaust, and, second, the efficiency as obtained from calculating the energy of the coal fed to the furnaces and the mechanical energy developed at the band wheel of the engine. The author shows quite correctly, that in the former case the efficiency is 10.5 per cent. while in the latter it reaches only 8.45 per cent. Dividing one by the other the author states that, "therefore the true efficiency of the engine is 80.5 per cent." Although this statement is not calculated to mislead those well versed in steam engine practice it is nevertheless ambiguous and may give a wrong impression to students, and to that extent is open to objection.

The work contains methods of testing iron and tables for the determination of ampere-turns for field-magnets, tables for obtaining the potential differences at the terminals of coils, together with methods for determining the size of wires for armatures and field coils. To these is added the final appendix for determining the size of belting. The work throughout will prove of considerable aid to students and is particularly to be commended for its strongly practical character.

OBITUARY.

PROF. TYNDALL.

PROF. JOHN TYNDALL, perhaps the most notable of modern British physicists, and one who possessed the gifts of clear explanation and vivid illustration in a degree not common among scientific teachers, died at his home at Hazlemere in Surrey, England, on December 4, from the administration of choral in mistake for sulphate of magnesia.

He was born in 1820, near Carlow, Ireland, of parents in very humble circumstances who traced their descent from Tyndal, the first printer of the Bible in the English language, and his whole youth was spent in a constant struggle to acquire a sound scientific education while supporting himself in various ways. In his eighteenth year he obtained a position on the Ordnance Survey where he served for four years and in 1840 went into railroad engineering with a Manchester firm, and worked under great pressure for seven years, devoting every moment he could spare to study. In 1847 he was appointed master in Queenswood College, and there studied chemistry under the guidance of Dr. Frankland. The following year he began the more systematic study of chemistry at Marburg University under Prof. Bunsen and devoted much time also to mathematics. In 1850 he published a paper on "The Magneto-optic Properties of Crystals, and the Relation of Magnetism

JOHN TYNDALL, L. L. D., D. C. L.

and Diamagnetism to Molecular Arrangement," which attracted general attention in the scientific world, and practically established his reputation. In the following year he went to Berlin, where he prosecuted his inquiries under the direction of Prof. Magnus, Clausius, Wiedemann, and Poggendorff. Humboldt he saw in his own home, and was intrusted by him with messages, of great scientific interest, to Faraday, with whom he began an intimacy ending only with the great electrician's death. In 1852 he was elected a fellow of the Royal Society and, in the following year, professor of natural philosophy at the Royal Institution, where he succeeded Faraday as superintendent. In 1855 Cambridge University conferred upon him the degree of LL. D., an example which Edinburgh followed in 1866, when Carlyle was installed as rector. The next five years was passed in literary activity and lecturing, and at the end of that period he visited the United States on a lecturing tour, delivering thirty-five addresses in different places to crowded audiences. The proceeds of this lecture course he devoted to the benefit of students engaged in original research. In 1873 Oxford conferred upon him the degree of D. C. L., and in 1876 he was married to Louisa Claud Hamilton, eldest daughter of Lord and Lady Claud Hamilton.

Among the principal works which he was the author may be mentioned "The Glaciers of the Alps," "Mountaineering," "Heat Considered as a Mode of Motion," "On Radiation," "Fragments of Science," "Notes on Light," "Notes on Electricity," "The Forms of Water in Clouds and Rivers, Ice and Glaciers," "Essays on the Floating Matter of the Air in Relation to Putrefaction and Infection," and a number of miscellaneous addresses on all kinds of scientific subjects.

We may add that our portrait is made from an excellent engraving forming part of the valuable collection of Mr. Park Benjamin.

HENRY GOEBEL.

THE death is announced of Mr. Henry Goebel, whose sensational claim to have anticipated everybody in the invention of the incandescent lamp has practically dominated all electric lighting affairs during the past year, and has been strenuously fought over in half a dozen courts. The story of Mr. Goebel's remarkable claims was first told in THE ELECTRICAL ENGINEER of Jan. 25, 1893, and at once attracted the attention of both hemispheres. It is now so well-known that there is no need to repeat it. The article named was illustrated by Mr. Goebel's portrait, lamps, etc. The deceased was born in 1818, in Hanover, and part of the evidence put in by defendants sued under the Edison lamp patent went to show that even before he came to this country in 1849 his thoughts and experiments had run in the direction of incandescent lamps.

SOCIETY AND CLUB NOTES.

THE NEW YORK ELECTRICAL SOCIETY'S WORLD'S FAIR SYMPOSIUM.—II.—(*Concluded*).

MR. TESLA concluded his remarks on his oscillators as follows: I believe that the apparatus will be used for many purposes, for instance, governing all sorts of mechanisms, engines and so on and the disruptive discharge coil will now be more successfully employed. This was one of the features which had interest for scientific men, but this was merely a detail of the work which I have been doing. You have seen a few designs of engines described by a previous eminent speaker (Dr. C. E. Emery) who is one of the most competent to speak on the subject and who has shown us a great many complicated mechanisms. They are exactly adapted to illustrate what I have to say. When looking on them we must ask ourselves whether it is not worth while to attempt to simplify these mechanisms which we have been using heretofore for the production of electric currents. When we examine a steam engine and inquire where the power comes from that drives the engine, we will find that the power comes from a little box—a cylinder with a piston in it, and all the other appurtenances are really for nothing but to keep it going. You may do away with the fly wheel, with the cross-heads, with the eccentrics, with valves and all the other appliances, provided that you can in some other simple way govern the motion of the mechanism. So then my first idea was to apply the motion of the piston, which is freely movable, to a magnetic field, to move a magnet or a coil in a magnetic field and so generate currents by this direct motion. Then regulate the currents, instead of regulating the mechanical motion. Now let us see what we gain in so doing. First, we reduce the weight of the engine for the same pressure and the same piston speed to $\frac{1}{30}$ or $\frac{1}{40}$, if not $\frac{1}{50}$ of its weight. Furthermore we do away with all mechanical frictions. The engine designed according to my ideas has a mechanical efficiency of 99¾ per cent. Now that is in itself a very big item and renders it worth while endeavoring to make this mechanism a commercial success. But there are other far or more important things having bearing upon the thermic efficiency. You will find that engineers often say what an advantage it was to apply the direct motion of the steam piston to a pump. In reality the advantage in a pump is but a very minute one. The water column has got an enormous inertia and what we do gain in the direct acting pump is merely a matter of overcoming some additional friction which we have in the ordinary engine. We may take the mechanical efficiency—I gather the data from various works—we may take the efficiency as, say, 81 to 82 per cent. at full load. But the efficiency is much less on a varying load. I take the figures which I believe to be fair. Now the dynamo again has mechanical losses due to friction, and furthermore the wire is never utilized fully in the dynamo. In my construction the dynamo may consist of a circular coil and a magnet, the coil being all immersed in the magnetic field. There is no useless wire; consequently dynamo and engine are reduced considerably in weight and increased in efficiency. There is only one engine which can equal it in output and that is the turbine. With the steam turbine we can obtain an enormous output, and that is the reason why the steam turbine, in my opinion, may find a valuable employment for driving alternating dynamos, and then converting the motion by means of alternating motors possessing a greater number of poles than the generator. In this way the speed may be reduced without the objectionable mechanical gearing. But I think that the steam turbine has in itself a physical cause why it cannot surpass a certain efficiency, namely it is driven by impact. A turbine might be very efficient if the medium which propels it were incompressible and homogeneous. But it cannot be efficient if we drive it by means of isolated shocks and these cannot be overcome by any design of the blades. Furthermore, we cannot in a turbine gain much from the expansion. These causes, I think, will limit the efficiency obtained in turbines. But in reciprocating mechanisms we may, provided we can obtain a sufficiently high speed of the piston, expand the steam at an enormous rate. It is perfectly practicable in these mechanisms which I have been working up to obtain, if you want, a speed of 100 metres a second, and while I do not contemplate producing such speeds yet it is quite possible to do it. But since we can produce higher speeds we might as well increase the speed two or three times and so augment the activity of the mechanism and raise the efficiency. Again, as I am enabled now to work without a packing, having found that in these mechanisms the packing is actually unneccessary, the expansion occurring at an enormous rate and the engine being of such character that the exhaust can be reduced to pretty nearly the atmospheric pressure very easily, the mechanical friction is reduced to such a small figure that we can raise the temperature of the steam very considerably. You know that in high pressure steam engines one of the greatest troubles is the lubrication. We can go so far with ordinary oil, we can go so far with mineral oil, but then we reach a point at which we cannot go any farther; the lubricant will not work, and I am informed by very able practical engineers that about 250 pounds per square inch of steam pressure is as high as we can practically go. With this engine we can go much higher. I am now getting a boiler which will give me up to 350 pounds pressure. It is very important, of course, to get the pressure very high. In these mechanisms we are confronted with two opposing tendencies. The question is: For what are they going to be used—for light or power? If we want to drive motors we must have a long stroke and a small frequency. If we want to drive lamps then we want a very short stroke and a very rapid motion. To have a high speed with short stroke we must have a great initial pressure, because you know the number of vibrations increases only as the square root of the pressure. So if we want to have twice the number of vibrations we must have four times the pressure. But, on the other hand four times the pressure and twice the number of vibrations means eight times the output. Hence the importance of having the high pressure, especially for purposes of lighting. It is on this line now that I am working.

[An illustration of the Tesla electrical oscillator and a section of the cylinder was then thrown on the screen by means of a lantern and the speaker described them.[1]]

There is nothing novel in the production of this reciprocating motion. We have such reciprocating engines as far back as 1868 or 1870, and it would be a very erroneous idea to think that I had evolved something radically novel in that part of the mechanism, but I have perfected it in many features and rendered it more economical. I have to add that it is more economical to produce rapid vibrations than slow vibrations, which means a short stroke. But so far as the economy of the dynamo and the economy of the engine in general is concerned it is better to produce a long stroke, because a long stroke means a high velocity.

I have an apparatus which runs lights in my laboratory and shortly I think I shall have something which will be ready for practical application. I think I am not mistaken in believing that we are going to have in a short time a means at hand of producing twice as much electricity from coal as we can produce at the present time—provided I am not mistaken. This is subject, of course, to a test, but I am quite confident that it can be done. This is not, however, a subject which occupies me altogether. There are also other subjects. (Applause).

MR. J. J. CARTY was next introduced and spoke on

TELEPHONY AND THE WORLD'S FAIR.

To give a proper idea of the telephone work at the Fair, said MR. CARTY, would mean a review of the present state of the art, which, of course, was out of the question. It was particularly and almost exclusively an American exhibit. The foreign telephone exhibits were of little interest or novelty and some of them were copies of what had been developed in this country. The general feature of telephonic work at the Fair was interesting more from the tendencies which it exhibited than from any details of structure. It seemed that the later work of telephony had been confined more to doing those things which we knew how to do and doing them well, than in trying to find out things we did not know. This was well exemplified in the working of the Long Distance line. Among the marked tendencies was the movement away from series work which was begun at the Detroit Telephone Convention, towards multiple arc work, not only in subscribers' stations but in the exchange system as well. The former troubles with bad contacts at the spring-jacks had also been successfully overcome. The exhibition of underground telephone cables was very complete and America probably leads in this respect.

MR. JAMES HAMBLET then gave an account of the

ELECTRIC CLOCKS AT THE WORLD'S FAIR.

Of these there were over 200 in all, operated from a master clock distributing standard time. Of these some 70 were operated by the Self-Winding Clock Co. in the Exposition and various State buildings while some 90 or 100 were placed in the Manufactures and Liberal Arts Building alone, ranging from a tower clock to a mantel clock. Besides these there were a few clocks exhibited in the Electrical Building including an intricate and delicately made apparatus for transmitting time, exhibited in the German

1. For a full description see THE ELECTRICAL ENGINEER, Nov. 8, 1893.

section. He also noticed a number of chimney clocks, signal clocks and program clocks.

DR. EMERY supplemented his previous remarks by calling attention to the De Laval turbine which drove a dynamo, running at a speed of 20,000 revolutions per minute.[1] Mr. TESLA also made some further remarks in elucidation of his statements on the efficiency of steam turbines.

CHICAGO ELECTRICAL ASSOCIATION.

AT the last meeting of this Association, Mr. G. Monrath read a paper on "The Electrostatic Production of Ozone and its Commercial Applications," illustrating it with diagrams and pictures of ozone-generating apparatus as used at the Marseilles plant. This paper proved to be very interesting and drew out a quite general discussion. At the next meeting, Dec. 19th, Mr. Albert Scheible will read a paper entitled "Notes on Some Wiring Tables." This association was formed merely for technical discussions and is composed of young men representing the various electrical interests at Chicago.

LEGAL NOTES.

GENERAL ELECTRIC COMPANY v. WARING ELECTRIC COMPANY.—IS THE "NOVAK" LAMP AN INFRINGEMENT?

THE hearing for a preliminary injunction applied for by the General Electric Company against the Waring Electric Company, manufacturers of the "Novak" incandescent lamp, took place before Judge Shipman, in Hartford, Conn., on Saturday the 9th inst. Messrs. F. P. Fish, Clarence Seward and Richard N. Dyer of New York, represented the plaintiffs and Messrs. W. E. Simonds (ex-commissioner of patents) of New York, Charles E. Perkins of Hartford, and R. M. Morse acted for the defendants. Prima facie affidavits were offered by the plaintiff, moving for a temporary injunction, and a large number of answering affidavits were put in by the defendant, after which rebuttal affidavits were put in evidence by the plaintiff. Mr. Dyer opened the case for the plaintiff and spoke for an hour, the gist of his remarks going to show that the defendants had a very high vacuum in their lamp, and that they therefore infringed the patent of the Edison lamp,—the introduction of a small quantity of bromine at an attenuated atmosphere being insignificant. He went on to show that of the quantity of oxygen originally contained in one of the Novak lamps, at completion only one three millionth part of it remained. In making the Novak lamps the atmosphere was first exhausted to about $\frac{1}{600}$ of an atmosphere, than a little bromine gas was introduced, and then the lamp exhausted again to $\frac{1}{600}$ of an atmosphere. Bromine was again introduced and the operation repeated until only $\frac{1}{3000000}$ part of the original oxygen was left. He maintained that the lamp was practically a vacuum lamp and could not exist but for the features possessed by it, which infringed Edison's patent, that the bromine was immaterial and that really the lamp depended on the vacuum for its existence.

Mr. Simonds then followed, claiming that the vacuum in the "Novak" lamp was never less than $\frac{1}{500}$th, and stated that Mr. Dyer's calculations were misleading. Although oxygen might exist in the "Novak" lamp in only $\frac{1}{3000000}$ of an atmosphere, yet there was a bromine atmosphere there at a pressure of never less than $\frac{1}{500}$th of an atmosphere. In proof of what he said, he claimed that the Edison Company had always maintained that mercury pumps were necessary to produce a sufficiently good vacuum for an incandescent lamp, and that the Waring Company had never used a mercury pump, but only ordinary power pumps, whose maximum was $\frac{1}{1000}$th of an atmosphere. Also, that the Edison Company claimed that to make a successful incandescent lamp it was necessary to run a current through the filaments during the process of exhaustion, so as to force out and eliminate the occluded gases in the filaments, and that this process was not used by the Waring Company. Then he showed the judge the presence of the gas by shaking the filaments of two lamps, one a Novak and the other a vacuum lamp, the filament of the gas filled lamp coming to rest after a very few seconds, showing the density of the gas in the bulb. He maintained that the bromine atmosphere was a new invention, a genuine substitution for a vacuum, and gave better results. In conclusion he said: "Either we have a vacuum or not,—a vacuum or a bromine atmosphere, the two cannot co-exist."

After speaking for about two hours, Mr. Seward took the floor on behalf of the plaintiff. He brought out the fact that the Waring Company used the Perkins filament, a filament that was now under injunction by this very Court, and endeavored to show that the Waring Electric Company was just the Perkins Electric Lamp Company under a new name. He stated that the occluded gases in these filaments might well be taken out before they were sold to the Waring Company, as they were bought by the Waring Company from Mr. Perkins, all ready and in condition to be put into the lamp bulbs. He maintained that the introduction of the gas was a secondary step, and that the Waring Company had to use all the essential primary steps of the Edison lamp, and was therefore a direct infringement. "Take away," he said in conclusion, "the Edison features of this lamp, and nothing is left."

Mr. F. P. Fish finished the arguments for the day. In his usual forcible style he endeavored to show that the "Novak" lamp was simply an evasion of the Edison patent. All the features of the Edison lamp were present in the Novak lamp. To look at two lamps, one a Novak and one an Edison, it would be difficult to tell which was which. There was the all glass globe, the leading-in wires passing through the glass, the filamentary carbon, and lastly there was a vacuum, even though it contained a slight trace of bromine. The introduction of bromine which was afterwards pumped out, was simply an evasion. "If," he said, "the defendants had put in a gas at atmospheric pressure they might have had some good reason for standing as defendants before your Honor, but with their present vacuum they have no right to expect a judgment in their favor."

Judge Shipman reserved his decision.

GOVERNMENT TELEPHONE SUITS.

THE Attorney-General, Mr. Olney, has just made his annual report to Congress. The report refers to the bill in equity brought in the district of Massachusetts in January, 1887, concerning the Bell telephone cases and says that up to the close of the fiscal year 1893 this suit had cost the government in counsel fees alone $80,628. In the other Bell telephone suit, known as the "Berliner suit," the evidence for the government has already been closed, and the defendants' testimony is now taking. The counsel on both sides agree that in all probability the case can be got to a hearing at least as early as the first of May next.

DYNAMO REGULATION SUITS.

THE EDISON ELECTRIC LIGHT COMPANY has filed a bill of complaint against the Mather Electric Company of Manchester, Conn., alleging an infringement of a patent for regulating the generating capacity of dynamo-electric machines.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

TEST OF THE AMERICAN DOWN DRAFT BOILER.

THE American Down Draft Boiler, for which Mr. Albert Blanchard of No. 685 The Rookery is agent, is apparently meeting with a great deal of favor wherever it is in use. Those investigating it approve of this system where economy of space and fuel is an item, and they seem to be doing remarkable work.

An 8-hour test made November 22nd, at the Columbus Memorial Building, Chicago, by R. W. Hunt & Co., on two boilers, showed an actual evaporation of water per pound of fuel of 10.065 pounds, and an evaporation per pound of combustible from and at 212 degrees, of 11.298 pounds.

It was intended to make the first four hours' run with one boiler. Too much load, however, was put on but taken off again about the time the second boiler was ready to put in service, and it was found that there was too much boiler capacity during the first few hours of the test. The boiler had also been in service two weeks without cleaning, except the blowing of the tubes with a steam flue cleaner.

One of the boilers was thoroughly cleaned on November 26th and another test, made November 27th using one boiler, showed an evaporation from and at 212 degrees of 12.85 pounds of water per pound of actual combustible.

Each of these tests was made by weighing fuel and water on Fairbanks standard scales. At times in the first test 366.8 h. p. was developed on the basis of 34½ pounds of water per h. p. hour, and in the second test the first hour showed 328 h. p. on the same basis, which is 118 per cent. over the builders' rating.

STIRLING BOILERS AT THE WORLD'S FAIR.

WE have received the following from the Stirling Co.:

The failure on the part of the World's Columbian Exposition to have exhaustive tests made on the various boilers in the main boiler room of the Machinery Hall has given rise to considerable discussion amongst those interested in boilers and the generation of steam. A brief statement of the conditions under which the several plants were installed, as well as for the different records that were kept of their operation may therefore be of interest.

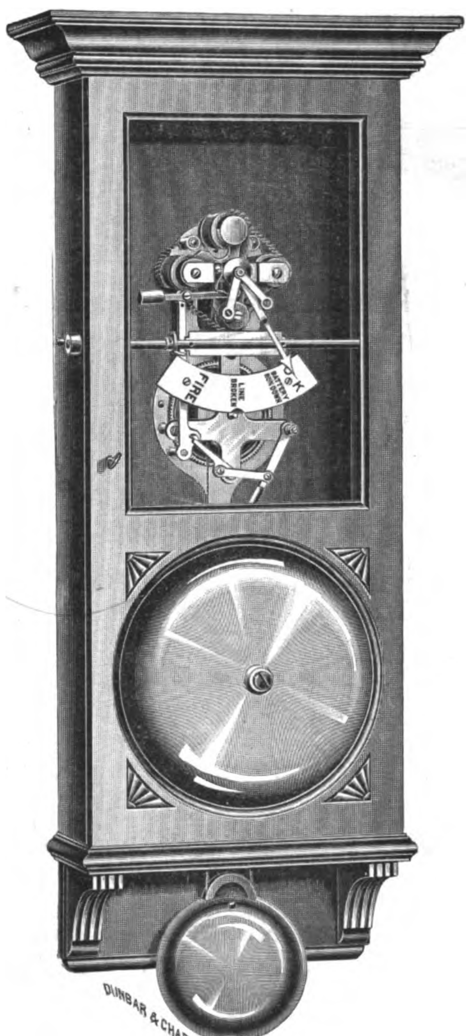
It can be safely said that nearly all the boiler companies at the time that they installed their plants assumed that awards would be based largely upon the results of evaporative tests. It was found, however, that no appropriation had been made for the purpose of defraying the expense of these tests and consequently each exhibitor was asked to submit to the charge of having his own

1. For a full description see THE ELECTRICAL ENGINEER, Dec. 6, 1893.

boiler tested; none however, as far as can be learned would agree to this with the exception of the Stirling Company, who addressed a letter to the Jury of Awards expressing a willingness to enter into a competitive test with any of the companies whose boilers were installed at the Main Boiler Room. The Jury of Awards believing the transmission of a message of this character out of their province, took no action upon it and here the matter dropped. The only method left the Jury to pursue was therefore to review the claims made by each company, investigating them as fully as possible both at the World's Fair and other accessible points and then sum up the result. The Stirling Company's claims were broad, comprising economy, efficiency, special adaptability to the use of bad feed water, ready accessibility for cleaning and examination by the removal of four manhole plates, entire absence of cast members, insuring absolute safety, simplicity of construction, ample provision for expansion and contraction and great strength and durability. These claims were fully considered and the plant at the World's Fair was not only submitted to the severest scrutiny, but one of the members of the Jury was detailed to examine boilers at other points both in and around Chicago, as well as in Circleville, O., Pittsburgh, Pa., and Allentown, Pa. All these investigations were certainly thorough enough to suit the most fastidious and resulted in a medal and diploma being awarded the Stirling Company allowing the substantial claims made by it.

THE BROWN AUTOMATIC FIRE ALARM SYSTEM.

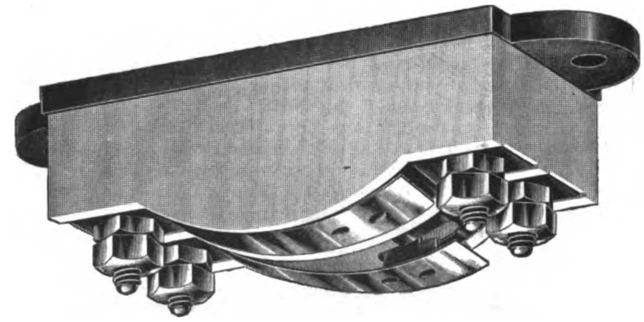
All closed circuit fire-alarm systems which depend upon breaking the circuit to sound the alarm are subject to the fault of sounding false alarms whenever the line is broken or short-circuited by accident.



Brown Automatic Fire Alarm.

To obviate this, it is necessary that the thermostat in acting shall make some change in the line which is never made by accident, and that the receiving instruments be so arranged as to indicate what change has taken place.

In the system recently devised by Mr. Gilman W. Brown, of West Newbury, Mass., by very simple mechanism, the thermostat in acting reverses the current instead of simply stopping it. Reversing the current is a change which never occurs by accident; hence, the receiving instrument will never indicate fire unless a thermostat has acted. The receiving mechanism consists of a very simple and reliable electro-mechanical gong, controlled by a polarized armature of the rotary type, to which is attached a pointer moving over a suitable dial arranged to show just what change has occurred in the line. This dial is marked "O. K." on its right hand end, below which are the words, "Battery Run Down"; in the middle, "Line Broken"; and on the left hand end, "Fire."



The Brown Thermostat.

The magnet and armature are of new and unique design, giving a long movement of the latter with a very small current. This enables the system to be maintained at a very small expense, the battery used being the common gravity. The polarity of the armature of this magnet can never, it is claimed, be reversed by any of the accidents to which a system is liable, nor stick to the poles of the magnet nor require readjusting. This armature is brought to centre by small weights which, in practice, are more reliable than springs. A very important feature of this apparatus is that the battery current can rise much above or fall much below the normal without affecting the working of the system. The system can be arranged with two bells, one of about eight inches in the engine house to ring for fire only, the other of small size to call attention to trouble with the line. A large striker is also provided to strike a factory or other large bell one blow to indicate trouble with the line, and continuous ringing to indicate fire. This is important in places where firemen are not on duty at all times.

The construction and operation of the thermostat are as follows: Upon the lower side of a porcelain base are clamped two flat bronze springs, which are held under tension by a fusible solder, the melting point of which can be changed to suit different positions. To the upper side of this base is clamped a plate of vulcanized fibre, through which screws pass into the ceiling to fasten the thermostat in position. In the centre of the porcelain base and covered by the fibre plate is moulded a cavity which contains electro-plated contact points brought into action by releasing the springs. These contact points are punched from sheet brass and rivetted to the bronze springs, extending through the porcelain into the cavity referred to, and so arranged as to press against electroplated copper strips connected in such a way as to reverse the current when the springs are released by melting the solder. The working parts of this thermostat are entirely protected from dust and insects. The part sensitive to heat is entirely uncovered and in the best possible position to be affected by direct rays as well as by the heated air from a fire, and, being thin, acts promptly and will never change its adjustment.

In case the battery should be allowed to run down, the armature would be drawn towards its central position by the weight until the hand pointed to "Battery Run Down," when the striking mechanism would be unlocked and the bell strike. The attendant, on looking at the dial, sees that the bell is striking because the battery is run down, and to silence the bell turns over the small handle on the left hand side of the case, which, besides stopping the striker, turns up a card over the dial, marked "Disconnected," which shows that the system is inoperative. Even under these conditions, the system will sound an alarm in case a fire should occur, unless allowed to stand too long. In case of a broken line or short circuit (which in this case is equivalent to a broken line), the same thing takes place, excepting that the pointer indicates "Line Broken." In this case, when the line is repaired, the bell again strikes to notify the attendant that the line has been repaired, and the band points again to "O. K.," the bell being silenced by turning the lever and card back to the original position. In case of fire, the bell rings, and the pointer is carried to the word "Fire" and locked in that position where it remains until released by the attendant.

The Texas Electric Brokerage Co., of Dallas, Texas, are opening a general electrical brokerage business, selling electrical supplies as manufacturers' agents.

ROPE TRANSMISSION AT THE HOTEL NEW NETHERLANDS, NEW YORK.

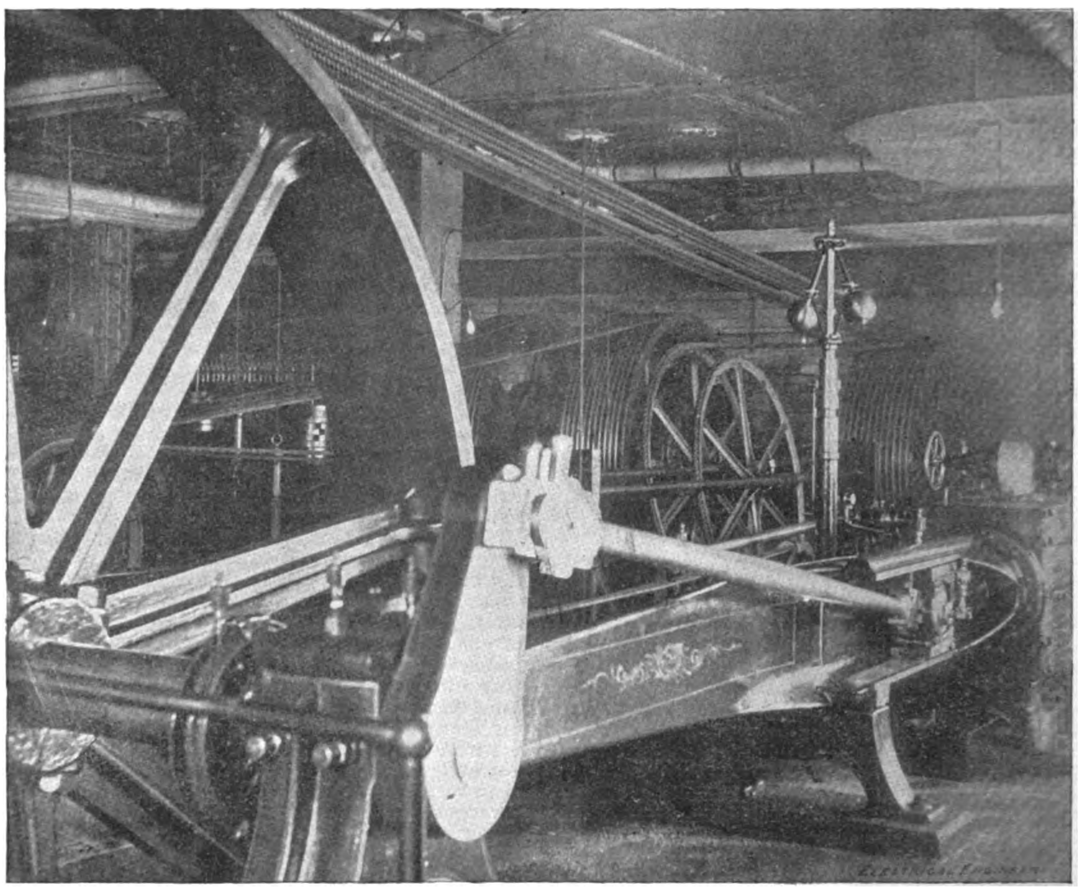
The power plant in this hotel is claimed to be superior to anything yet constructed for the purpose, as a maximum power has been successfully installed in a minimum space, yet leaving sufficient room for easy access to every machine. The power is derived from two Corliss engines, which are placed one at each end of the engine room, one of 325 h. p. and another, smaller one, of 250 h. p., both having 14 foot fly wheels, grooved for cotton rope. The line shaft runs along in front of the engines on solid stone pedestals close to the end wall, and is driven from each end by one of the Corliss engines. In the centre of the shaft a friction clutch coupling is placed, so that either engine may be used for driving a part or the whole of the shaft.

The fly wheel on the 325 h. p. engine has 13 grooves turned in it for 12 strands of 1⅜ inch Lambeth cotton rope, which is divided into two units, each consisting of six continuous strands, either rope being sufficient to transmit the power in case of necessity. These ropes lead from the fly wheel to a 66 inch sheave, on the line shaft, which is fitted with a sleeve and is operated by means of a friction clutch, so that the line shaft can be thrown in or out of gear without stopping the engine. The 250 h. p. engine has 10 driving strands, but otherwise is similar to the above. By this arrangement it is possible to throw the power from one engine to the other at full speed; or by throwing out the central coupling to let each engine operate separately.

The dynamos, four in number, three of 100 k. w. and one of 60 k. w., are driven from the line shaft by means of raw hide rope, each dynamo, similar to the engines, having two sets of continuous ropes, thus insuring an even distribution of the power and a double safety. The driving sheaves, which are 7 feet in diameter, are fitted with friction clutches, enabling them to be thrown in or out at will. As the dynamos are driven by means of rope it enables them to be placed quite close up to the line shaft, which would be impracticable with belts, thus saving valuable space; and most careful tests have failed to detect any slippage whatever, consequently, insuring a steady light. Another great advantage is the absence of all noise and vibration throughout. The well-known noise of leather belts running at high speed, with their other disadvantages, are in this case conspicuous by their absence, as there is not a foot of belt used for transmitting power in the engine room.

Particular attention has been paid to the tension device, one strand of each multiple rope passing over a sheave on a traveling carriage, which keeps the strain on the ropes constant for any given horse power regardless of the variations in length of rope, due to moisture or natural stretch caused by use. It instantly takes up any slack caused by a sudden increase of load, as in switching on a number of lights, or gives back slack when the load is relieved. There are two of these tension carriages to each engine and each dynamo, as shown in the accompanying engraving. Besides the two Corliss engines, there is a 130 h. p. high speed engine, placed in the space between the fly wheels of the Corliss engines, driving a 100 k. w. dynamo, with rope similar to the others in every respect.

It will thus be seen that this plant is so designed as to render a complete stoppage of it, owing to accident or otherwise, almost impossible, as the load can be transferred from one engine to the other, or from one half of the line shaft to the other, and half the number of ropes on engines and dynamos might be rendered useless without interfering with the operation of the others. This machinery was manufactured and installed by the Link-Belt Engineering Company, of New York and Philadelphia, for the General Electric Company.



Rope Transmission in the Hotel New Netherlands, New York City.

PURITY OIL FILTERS.

Among many recent testimonials received by the Purity Oil Filter Manufacturing Company, of Pittsburgh, Pa., are those of the Metropolitan Street Railway Company, of Macon, Ga.; Pearson Cordage Company, Boston, Mass.; Rockaway (N. J.) Manufacturing Company; Southern Pacific Railroad Company, and A. L. Ide & Son, the engine builders, of Springfield, Ill. All the letters speak highly of the ideal refiner, mentioning particularly the great saving which follows the use of this appliance.

RATING CENTRAL STATIONS.

A new schedule of rates soon to come before the Chicago Fire Underwriters' Association for adoption makes the basis rate for frame electric light stations $2.50, and for brick structures of first-class construction, $1. It is argued that no frame station is first class.

CARPENTER ENAMEL RHEOSTATS.

THE CARPENTER ENAMEL RHEOSTAT Co., for whom Mr. Chas. D. Shain, of 136 Liberty street, New York city, is selling agent, have issued a handsome catalogue of 40 pages, illustrated by about 29 half-tone engravings of the various forms of this well-known device. Its excellent features are set forth anew in a way that cannot fail to impress even the sceptical, and a preface by the president, Mr. H. Ward Leonard, informs the reader that, although the company is practically alone in its particuliar field, the prices of the rheostats have been still further reduced.

FIG. 1.—CARPENTER MOTOR RHEOSTAT.

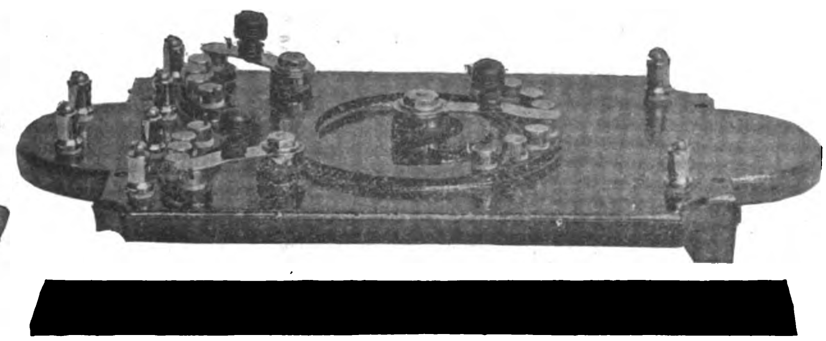


FIG. 3.—CARPENTER DENTAL RHEOSTAT.

The readers of THE ELECTRICAL ENGINEER will remember the full and profusely illustrated articles on these apparatuses in our issues of June 11 and June 28, last. Besides the forms there referred to, however, certain new ones have made their appearance and are shown in the accompanying illustrations.

In many cases rheostats are wanted without a regulating switch, especially in cases where switches of special design are required and also where it is desirable to have the rheostat located some distance from the switch. Such apparatus is furnished in several forms and in all sizes and capacities of resistance and current capacity. The rheostat shown in Fig. 1 is composed of 8 plates 14" x 14" supported between end frames. The plates are operated in series but the wires on the plates are in multiple, thus giving the rheostat a heavy current capacity with few external connections. These rheostats are well adapted for motors operating traveling cranes, hoists, railway motors, etc., and are provided with binding posts or nuts for readily attached wires leading to the switch.

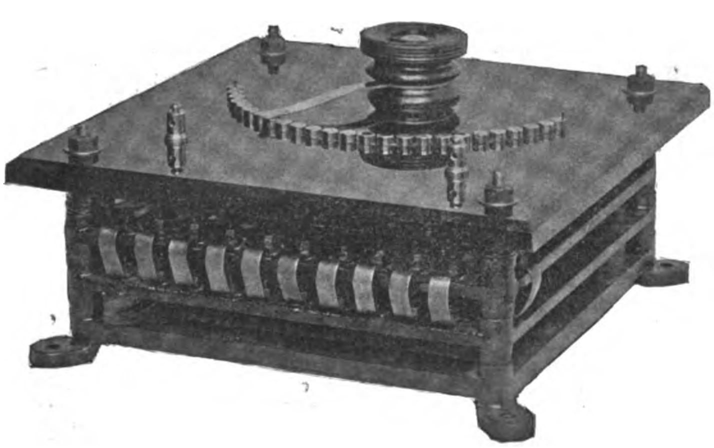


FIG. 2.—CARPENTER CAUTERY RHEOSTAT.

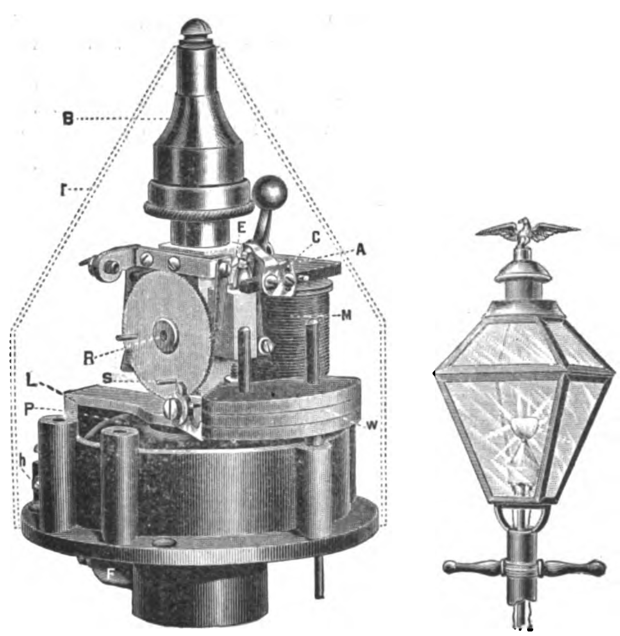
Fig. 2 shows a cautery rheostat for operating on incandescent lighting systems of any voltage. The current passing through the cautery is derived from the amount passing through a permanent resistance contained in the rheostat and the voltage and strength of current used on the cautery may be controlled by the rheostat switch. The rheostat is provided with two pairs of binding posts, one for connecting to the lighting circuit and the other pair to the cautery. Where the current exceeds 15 amperes, a switch of the knife blade type is used.

Fig. 3 shows a special rheostat manufactured for the S. S. White Dental Mfg. Co. for regulating dental motors, etc., three rheostats being combined upon one plate and occupying exceedingly little space.

The last ten pages of the catalogue are filled with testimonials of a most gratifying character from users of the Carpenter rheostat.

THE CUTLER SYSTEM OF LIGHTING AND EXTINGUISHING STREET GAS LAMPS WITHOUT WIRES.

MANY plans have been proposed in the past for lighting and extinguishing gas lamps electrically from a central point but up to the present none has proved sufficiently practicable to warrant its general adoption. The Cutler system discards the unsightly overhead wires and the expensive underground circuit, and adopts an entirely new and inexpensive method. Each lamp is supplied with two sal ammoniac batteries and a spark coil placed in an iron box buried in the ground at the foot of the post. In the lantern is a miniature gas holder of about 2 cubic inches capacity, pivoted on a hinge and held down by weights; and directly over this holder is an automatic gas lighter, similar to those used in houses, only larger and stronger. Two wires about ten feet long connect the lighter with the batteries through the post. Such an installation is under complete control from the gas works.



FIGS. 1 AND 2.—THE CUTLER ELECTRIC GAS LIGHTER.

When it is desired to light the lamps of a city, it is only necessary to open a valve connecting one of the large gas holders at the works, direct with the gas mains. This results in a decided increase of pressure in the gas all over the city, sufficient to cause all the little gas holders in the lamp posts to lift up about one-eighth of an inch against a platinum stop, and thus close the local battery circuit at each post. The automatic lighter being

then supplied with current, immediately turns on and lights the gas. In a word, the system is merely a huge pneumatic push button, and corresponds precisely to pushing a button when desiring to light the gas in a house supplied with automatic lighters.

The accompanying engraving, Fig. 1, shows the lighter about two-thirds full size. P is the pressure gauge or gas holder sealed with mercury and held down by the weights W. When the gauge lifts, it closes the electric circuit through the magnet M; the armature A is attracted and caused to vibrate, throwing sparks at E and turning the ratchet wheel R. The first movement of the ratchet wheel admits the gas to a small auxiliary outlet at E, as well as to the main burner. The electric sparks formed at E, ignite the auxiliary jet, which immediately shoots up and lights the main burner. As the ratchet wheel continues to turn, the auxiliary jet is closed, leaving the main burner open. The ratchet wheel is finally stopped with the gas turned full on and lighted, by a pin in the wheel striking against a stop S attached to the pressure gauge P.

It has been shown in practice, that 15 seconds is amply sufficient for maintaining this increased pressure, to give time to make the increase everwhere felt. It can be brought back to normal pressure; when the pressure gauge P will drop back and open the electric circuit. This operation, if repeated, will extinguish the lamps.

The mechanism of the lighter is extremely simple, and made so strong as to insure it from getting out of order or requiring attention of any kind. A heavy cast iron shell $\frac{3}{16}$ of an inch thick shown by dotted lines in the engraving, entirely surrounds the mechanism and thoroughly protects it from external abuse. No part of the lighter is exposed except the lava tip, which is easily replaced should it become stopped up or broken. An outlet at P, provides a passage for pouring in alcohol should any accumulated water freeze in the riser pipe in winter. The iron battery boxes are supplied with covers flush with the ground, which are intended to be removed once a year for cleaning the batteries. This operation constitutes the entire operating expense.

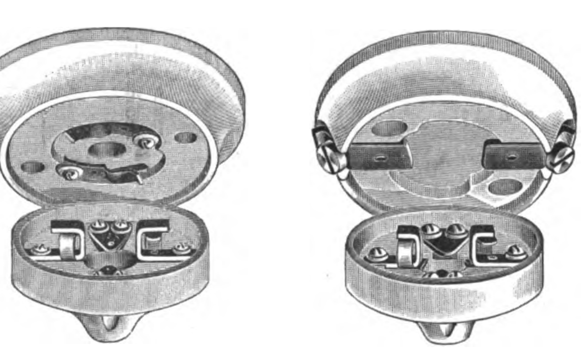
The burner used is of the Sugg type and gives a yellow flame without tongues and very little blue. It will consume exactly the number of cubic feet for which it is set under extremes of pressure varying from one to five inches of water. Fig. 2 shows the arrangement complete.

This system of electric gas lighting is controlled and manufactured by the Cutler-Hammer Manufacturing Company, of 247 South Jefferson street, Chicago.

METROPOLITAN ELECTRIC COMPANY.

THE METROPOLITAN ELECTRIC Co., of 522-523 Monadnock Bldg., Chicago, have secured the entire output of H. T. Paiste's factory and hereafter will exclusively sell these specialties.

A visit made to the factory enables one to see these various articles manufactured step by step until completed. First in importance is the making of "Eccentric" switches. These are the result of years of thought and experience on the part of Mr. Paiste, the pioneer switch maker. An important feature in the switch, we may mention, is that all the brass parts are fixed



FIGS. 1 AND 2.—PAISTE CEILING CUT-OUT, SCHAFFER STYLE.

firmly to the porcelain, without the use of screws. In porcelain there is "no cushion," hence screws will sooner or later jar out. The movement is of the eccentric order, thus insuring a positive mechanical action. The electrical connections are made by solder contacts. A test was made on a five ampere switch run for four days, making all told, about 70,000 half revolutions, or more than a switch would ordinarily make in fifty years. It carried a load of twenty-five amperes without heating the contact parts. The breaking capacity will easily break 500 volts. These switches are made single and double pole, and also three-way.

In the cut-out department is made in large quantities the Paiste ceiling cut-out, Schaffer style, for open and concealed work. Figs. 1 and 2 will readily demonstrate the simplicity and beauty of their design. Those of our readers who visited the Electricity Building at the World's Fair, will remember the very neat and artistic design made exclusively of these cut-outs, in Mr. Paiste's exhibit, illustrated in THE ELECTRICAL ENGINEER. Main and branch cut-outs of the "S. M." and Edison style are made in large quantities. A new covered branch and main block has just been manufactured that will be much appreciated by the electrical trade. A covered horseshoe cut-out is in process of manufacture and will be ready to deliver in a short time.

In the stamping department there is made out of flat sheet metal a clutch for Thomson-Houston arc lamps. Fig. 3 will illustrate the design and movement. The peculiar feature of this specialty is that it can be adjusted to a carbon rod and, therefore, is practi-

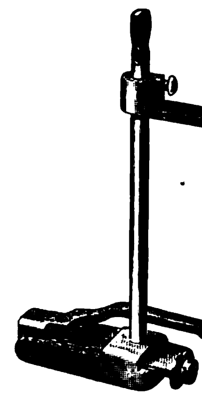


FIG. 3.

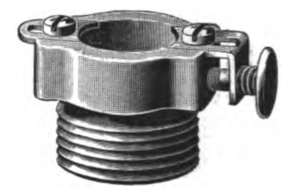


FIG. 4.

cally indestructible. German silver cantacts are used throughout. Here also is made an adjustable lower contact bushing for Thomson-Houston arc lamps; Fig. 4 illustrates the great simplicity of the device.

Numerous screw machines were also running, turning out binding posts and various other articles.

Another department just being organized is for the making of switchboards, etc., and here men are now busy making a complete set of switch and cut-out boards for the Ryerson Library, Chicago.

THE BECKER MILLER.

THE JOHN BECKER MFG. CO., of Fitchburg, Mass., send us a little story of a man who knew what he wanted and didn't mind traveling a few thousand miles to get it. We quote from their letter:

> Among recent shipments of vertical millers we made one to an Englishman who stated to us that he had thoroughly investigated the market of European makes of vertical spindle millers, and finally made up his mind that a certain machine of American make was what he desired. After seeing the World's Fair and on his preparing to return to London, he concluded to call on us at Fitchburg. Having been informed that the Becker miller was just becoming a popular machine and desiring the very best he could get, he went out of his course to see our machines in operation right at the factory.
>
> This Englishman very emphatically stated after spending an hour with us here in watching the working of our several sizes of this milling machine, that our No. 4 miller embodied more good points than, and was very much ahead of, any other machine he had ever seen here or abroad.
>
> He ordered a Becker Miller No. 4 with a number of extras which we shipped to him last week. We are now crating up another No. 4 to be shipped to Chicago, Ill.

"ACME" PORTABLE TESTING SET, "STYLE B."

IT is a well-known fact that Queen & Co., Incorporated, Philadelphia, have an excellent article in their portable testing sets, wound with platinoid wire. For several years they claim to have held the lead in resistance coils of all kinds both for laboratory and commercial purposes, and are now bringing out a "Style B" of their "Acme" engineering set which must surely meet with much favor. It is completely self contained, comprising a bridge and rheostat, D'Arsonval galvanometer, battery and keys, all mounted in a highly finished mahogany box, $8\frac{1}{4} \times 5\frac{3}{4} \times 5$ inches, that weighs less than six pounds ready for use. The extreme portability of the apparatus and the fact that rapid measurements can be made under conditions that do not admit of another type of galvanometer being employed, recommend the set to careful consideration.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. DECEMBER 20, 1893. No. 294.

THE POSTAL TELEGRAPH-CABLE COMPANY'S STORAGE BATTERY PLANT IN BALTIMORE.

BY

R. Macrae

ALTHOUGH storage batteries have been in use for some time in telegraph stations abroad, until recently no steps have been taken in this country to adopt them for this class of work. A description of the storage battery plant recently installed in the office of the Postal Telegraph-Cable Co., at Baltimore, will therefore be of interest to those who are using primary cells for similar work. This used at the same time. The loss in the transformer is inappreciable.

Although the voltage of one storage cell is only equivalent to that of two Daniell cells, it was found that on account of the low internal resistance of the storage cells a number of circuits could be operated from the same battery, and that where the working conditions are similar to those in the Baltimore office, one storage cell will replace five or more primary cells of the type now generally used. The fall of potential at the terminals of a primary battery when the circuit is closed renders it impracticable to work more than one or two circuits from the same battery. With storage batteries, on the other hand, the number of circuits that can be operated in parallel is limited only by the maximum discharge rate advisable for the size of the cells employed.

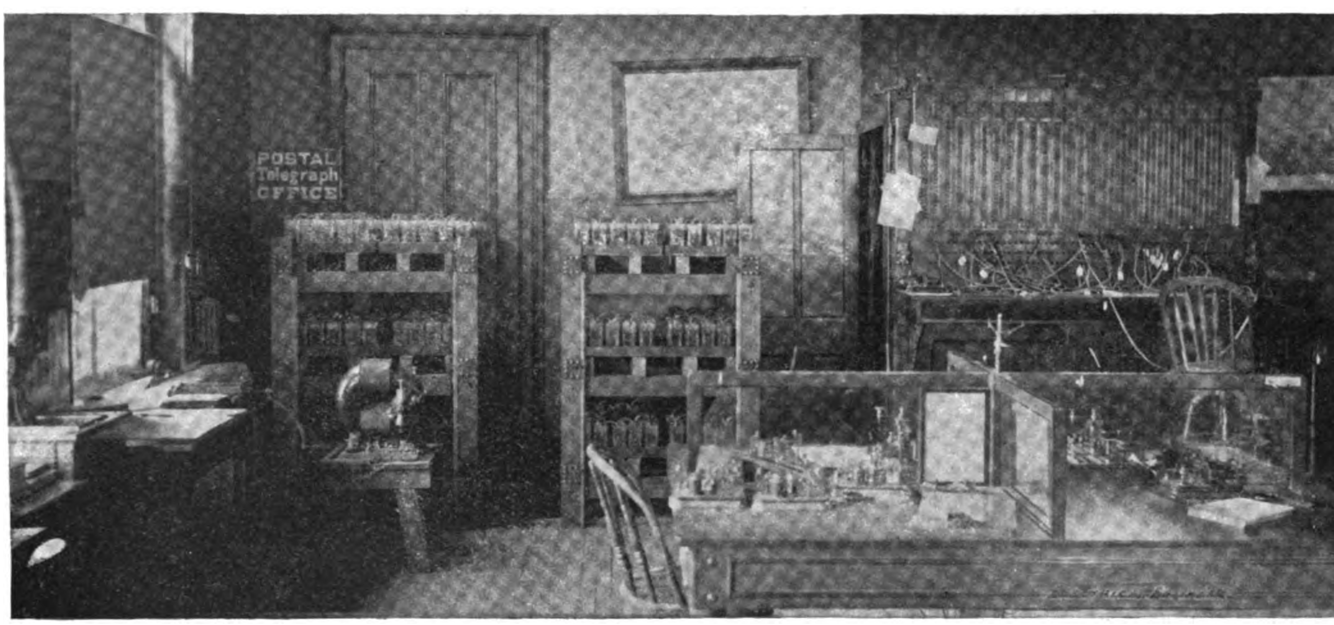


FIG. 1.—DONALDSON-MACRAE STORAGE BATTERY PLANT IN THE POSTAL TELEGRAPH OFFICE, BALTIMORE, MD.

is the first telegraph office in the United States to adopt this system and it is now using storage batteries exclusively for the transaction of its business.

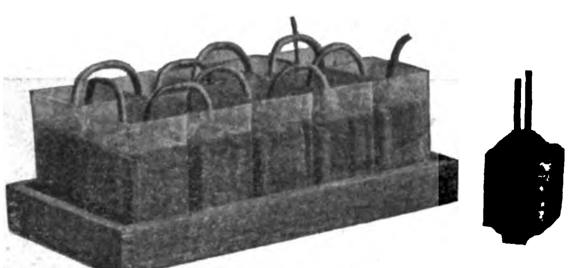
Before commencing to make the installation some preliminary tests were made in order to form an estimate of the size and number of storage battery cells that would most economically replace 2,500 large gravity cells formerly used and also to determine the most suitable method for charging the battery. As one end of a battery used on telegraph lines must be connected to the earth, it was found impracticable to charge the batteries direct from the street mains and at the same time use the batteries for telegraph work. To obviate the necessity of changing the circuits and using extra sets of batteries, a motor-generator was adopted for supplying current to the battery. In this way the street mains are entirely insulated from the charging circuit and the battery can be recharged and

With the above result as a basis, a plant of 500 Donaldson-Macrae storage cells of the type "3 A" with a ½ h. p. motor generator of the same make were installed a short time ago and are now found to be amply sufficient to do the work previously done by about five times that number of primary cells. In a larger station operating more circuits it would be necessary only to increase the charging facilities without increasing the number of cells, as all circuits requiring nearly the same voltage can be connected to the same battery.

The battery is placed on two stands, as shown in Fig. 1, each stand being capable of holding 300 cells and measuring four feet long, three feet wide and four and a half feet high. For convenience in handling, the cells are arranged in groups or trays as shown in Fig. 2, each tray containing ten cells. The element itself consists of one positive plate or section placed in a frame made of two half sections which

constitute the negative plate, as shown in Fig. 3. The insulating rubber rods are attached to the negative element in such a manner as to render short circuiting impossible and also to facilitate the insertion of a new positive element when renewals are necessary. Each element complete weighs $3\frac{1}{2}$ lbs. and has a capacity of 30 ampere hours. The glass containing jar measures 3 x 4 x 5 inches. The motor generator is shown in Fig. 1; it is operated from a 110 volt circuit and takes from 3 to 4 amperes and gives a charging current of from 2 to 3 amperes. Connected with the generator are fuse blocks and polarized trip-switches to prevent the battery current from passing into the motor generator in case of an interruption in the motor current.

The battery is divided into 12 groups or sections, one section being charged at a time. In each group of cells is placed a small hydrometer to indicate the state of charge of that section. Every morning the specific gravity, indicated by these hydrometers, is observed and the charging current is switched onto the battery which shows the greatest exhaustion. In this way the entire battery is always kept well charged. It is found that it is not necessary to keep the generator running at its full capacity to keep the cells in good condition. In fact the demand on the cells is such that the charging current might be interrupted for several days without interfering in any way with the battery service.



FIGS. 2 AND 3.—DONALDSON-MACRAE STORAGE BATTERY.

The advantage of using a storage system for this class of work has long been recognized. A Daniell cell in constant operation on a quadruplex circuit gives an average current of about $\frac{1}{10}$ ampere, or 875 watt hours per annum and costs to maintain, at the very lowest estimate, $1.10. The same number of watt hours, if furnished by the electric light companies of Baltimore, would cost (9) nine cents.

That lead batteries have not been adopted for this work before now, has not been due to a lack of efficiency in these batteries as reservoirs of electricity, but to the fact that the earlier forms of lead batteries could not be depended upon to furnish the interrupted service demanded in telegraph work. A cell was liable at any time to become short circuited, often by a particle of active material so small as to escape observation. A cell partially short circuited in this way would not only cease to contribute useful effect but would introduce a counter-E. M. F. more than sufficient to neutralize that of a good cell, thus diminishing the E. M. F. of the battery to the extent of about five volts. No amount of attention or care on the part of the person in charge of the battery could prevent these accidents, which were attributed not to faulty construction but to inherent defects inseparable from lead batteries. The long time that it has taken to overcome these defects has strengthened this opinion. Such sources of annoyance no longer exist in cells that are properly made and a lead battery can now be relied upon to do a certain amount of work with as much confidence as can be placed in any primary battery.

It is not here claimed, however, that a lead battery requires absolutely no attention or that the plates harden with age and last indefinitely. The negative plates, it is true, if properly made and protected from mechanical injury, show no signs of deterioration after years of constant service, but the positives have to be renewed every two or three years, depending upon the character of the work performed. The positives can of course be made to last longer by making the metallic support heavier, but for ordinary work nothing is gained by making the plates too heavy. Unlike the zincs in a primary battery, there is no destruction of the material in a lead positive and it can be reconstructed at a small cost. Replacing the positives is as simple an operation as renewing the zincs in a primary battery, and should be attended to before the plates are so far impaired as to interfere with the battery service. A gradual diminution of the electric capacity of the battery will indicate when new positives are needed.

In setting forth the claims of a lead battery it has not been usual to give too much prominence to the question of renewals. So much has been said about the ideal storage system, that a general impression exists that a storage battery with any claims to recognition should require even less attention than a water tank. If the depreciation factor is not reduced to zero, it is considered equal to an admission that the battery is still in an experimental stage, and unfit for practical application. It is safe to say that the storage battery of the future has contributed more than any other cause to retard the development of the storage battery of the present.

While the ideal system was liable to make its appearance at any moment, fully developed and applicable to every need, it was considered a waste of time to make any efforts to improve lead batteries, when it was plain that the principle involved did not admit of their ever becoming ideal batteries, free from such defects and limitations as have to be put up with in all other apparatus. In view of these circumstances, it is perhaps not to be wondered at that in some cases experience has not born out all the expectations of these users of lead batteries, or that when the cells were allowed to go to pieces from neglect, the whole system should be pronounced a failure. The rapidly increasing demand for lead batteries is, however, the best possible proof of their utility, and the results so far obtained from the installation above described, leave no room for doubt that a decided economy can be effected by the use of these batteries where the conditions are similar to those here met with.

A SIMPLIFIED METHOD OF CALCULATING DYNAMO OUTPUT AND PROPORTIONS.—II.

BY

Cecil P. Poole.

FIELD MAGNETS.

If one ascertains the most suitable density at which to work the iron or the field magnet, and the permeability of the iron at that density, dimensions and windings are readily predetermined, within reasonable limits, by means of simple formulæ.

Let A_t = ampere turns exciting a given magnetic circuit,
l = the length, in centimetres, of the exciting coil;
l'' = the length, in inches, of the same coil;
l_o = the length, in inches, of a closed iron magnetic circuit;
H = the number of C. G. S. lines per sq. cm. in air;
H'' = the number of lines per square inch in air;
B'' = the number of lines per square inch in iron, and
q = the permeability or conductivity of the iron.

Then from the well-known expression

M. M. F. $= A_t \times 0.4\,\pi$, we get

$$\mathsf{H} = \frac{A_t \times 0.4\,\pi}{l} = \frac{1.2566\,A_t}{l};\text{ whence}$$

$$\mathsf{H}'' = \frac{3.1918\,A_t}{l''}.$$

Now we know that $\mathbf{H}'' \times q = \mathbf{B}''$, therefore

$$\mathbf{B}'' = \frac{3.1918\, A_t q}{l_c},$$

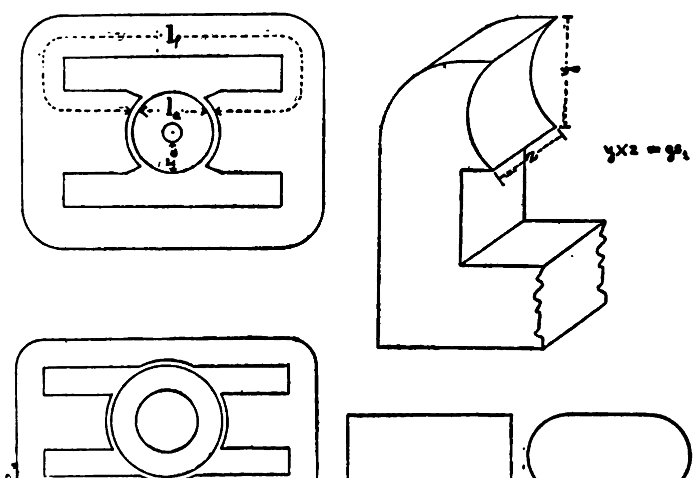
and transposing we have

$$A_t = \mathbf{B}'' \div \frac{3.1918\, q}{l_c} = \frac{\mathbf{B}''\, l_c}{3.1918\, q} = 0.3133\ \mathbf{B}''\, \frac{l_c}{q},$$

from which we may observe a fact frequently overlooked by writers upon this subject, namely, that the cross-section of a magnet core does not in the least govern the number of ampere turns required to produce a given magnetic density through a circuit of given length and material.

The expression, $A_t = 0.3133\ \mathbf{B}''\, \frac{l_c}{q}$, applies, however, only to magnetic circuits composed entirely of iron, and that of the same quality throughout. In designing dynamos and motors we must, therefore, follow Kapp's practice and calculate separately the reluctance of, or the ampere turns required by, each grade of magnetic conductor through which the lines of force must pass.

Let l_f = the average length of the (or each) magnetic circuit, in the field magnet;
l_a = the same in the armature core; (See Fig. 1);



FIGS. 1, 2, 3, 4 AND 5.

δ = the distance from the pole face to the armature core;
f_t = the cross-sectional area of the field core;
a_t = the cross-sectional area of the armature core (double the radial thickness $\times$ axial length);
g_t = the area of the air-gap; (See Fig. 2);
p = the number of pairs of poles on the machine;
q = the permeability of the iron in the field magnet;
q' = the permeability of the iron in the armature; and
$\mathbf{B}''$ = the number of magnetic lines per square inch *in the core of the field magnet*;

Then the total number of ampere turns required for the machine will be, minus leakage,

$$A_t = 0.3133\ \mathbf{B}''\, p \left(\frac{l_f}{q} + \frac{l_a \cdot f_t}{q' \cdot a_t} + \frac{2\,\delta \cdot f_t}{g_t} \right).$$

If the cross-sectional area of the magnet core is made to equal the area of the air gap, or if pole shoes are not used, we can write

$$A_t = 0.3133\ \mathbf{B}''\, p \left(\frac{l_f}{q} + \frac{l_a \cdot f_t}{q' \cdot a_t} + 2\,\delta \right) \quad . \quad (8).$$

It will be obvious that the most economical weight in iron is obtained when $a_t : f_t :: q : q'$, or to state it differently, when the radial thickness of the armature core is expressed by

$$r_a = \frac{f_t \cdot q}{2\, L q'}, \quad . \ . \ . \ . \ . \ . \quad (9),$$

L being the axial length of the core, counting iron only. When this equation is satisfied we can substitute for equation (8) the following expression:

$$A_t = 0.3133\ \mathbf{B}''\, p \left(\frac{l_f + l_a}{q} + 2\,\delta \right), \quad . \ . \quad (10),$$

which is a particularly convenient formula in that one has not to deal with any other than linear dimensions.

Of course leakage is not taken into consideration in these formulæ, and cannot be well handled by a general formula. It necessarily varies with the degree of magnetization, type of field magnet, etc. When the magnetic density does not exceed in the field magnet core 48,000 lines per square inch for cast iron or 90,000 for wrought iron the leakage for magnets of types akin to those shown by Figs. 1 and 3 will be covered by the expression

$$A_t = 0.36\ \mathbf{B}''\, p \left(\frac{l_f + l_a}{q} + 2\,\delta \right), \quad . \ . \ . \quad (11),$$

provided the cross-section of the magnet core does not exceed the proportion prescribed by equation (1), namely

$$f_t = \frac{D}{p}\, L \quad . \ . \ . \ . \ . \ . \quad (1),$$

where D is the outer diameter of the armature core. The value of A_t being determined, the size of the field wire may be ascertained within reasonable limits of temperature increase by use of the formula

$$d = \sqrt{\frac{1.05\, A_t\, l_m}{V}} \quad . \ . \ . \ . \quad (12),$$

where d is the diameter in mils of the bare wire, l_m the average or mean length in inches of each turn of wire, and V the difference of potential at the terminals of the coil or coils containing A_t. The value of l_m depends, of course, upon the size and shape of the core cross-section, and the depth of the winding from the surface of the coil to the core. Equation (1) will give a good value for the area of the cross-section, and the shape is purely a matter of personal preference beyond the fact that a round core is the most economical as to wire and energy, and a short oval one next. The depth of the winding on the core is also largely a matter of selection, varying in actual practice from $\frac{1}{6}$ to $\frac{1}{3}$ of the diameter of a round core, or the smaller thickness of an oblong one.

Let a represent the longer dimension of an oblong cross-section;
b = the shorter dimension of the same;
e = the diameter of a round core, and
h = the depth of the winding;

then the average length of each turn of wire on a round core will be expressed by $l_m = \pi\,(e + h)$, and the length of the extreme outside turns will be $L_o = \pi\,(e + 2\,h)$, while for a square core

$$l_m = 4\,\sqrt{f_t} + \pi\, h, \text{ and } L_o = 4\,\sqrt{f_t} + 2\,\pi\, h.$$

If the core has a rectangular cross-section, as in Fig. 4,

$$l_m = 2\,(a + b) + \pi\, h, \text{ and } L_o = 2\,(a + b) + 2\,\pi\, h,$$

and if the cross-section is an oval one, as in Fig. 5, then $l_m = 2\,(a - b) + \pi\,(b + h)$, and $L_o = 2\,(a - b) + \pi\,(b + 2\,h)$. The length of the maguet core, together with that of the coil space, will have been assumed before equation (10) or (11) can have come into use, and the current flowing in the field windings will be represented by.

$$A = \frac{A_t\, d_1^2\, 10^{-4}}{c_1\, h} \quad . \ . \ . \ . \ . \quad (13),$$

in which d_1 is the diameter, over insulation, of the wire, expressed in mils, and c_1 is the length of the coil space along the core covered by the coil or coils containing A_t.

It will be necessary to modify the values of c_1 and h as soon as that of d_1 is ascertained, so that each of the former shall be some multiple of the latter. This small variation in the value of h will not appreciably affect the values of l_m and L_0.

If the value of A should come out too high for good efficiency or proper temperature increase, it is obvious that c_1 or h (or both) must be given greater value than was at first assumed. From the standpoint of temperature increase the value of A should not exceed the limit specified by the equation

$$A = \frac{L_0 c_1}{2.7 V}; \quad . \quad . \quad . \quad . \quad . \quad . \quad (14),$$

and if the value of A as obtained by equation (13) does exceed this limit the current can be brought within bounds by lengthening the coil space to the extent of

$$c'_1 = A c_1 + \sqrt{\frac{L_0 A_1 . d_1^2 . 10^{-4}}{2.7 V . h}}; \quad . \quad . \quad (15),$$

where A is the quotient of formula (13), c_1 the length of coil-space first assumed, and c'_1 the corrected length of coil-space.

THE DYING OUT OF ALTERNATING CURRENT WAVES.[1]

BY

A. E. Kennelly

It has been asked how many times an alternating current could be transformed through successive induction coils without losing its essential wave character.

If the induction coils have no iron cores, the case depends entirely upon the shape of the wave of E. M. F. impressed at the terminals of the first transformer. Supposing that this wave were sinusoidal, then after the permanent state of steady activity had been attained, all the currents and voltages throughout the series would be sinusoidal. There would be attenuation, and change of phase along the series, but there would be no change of wave type, whatever the resistances, capacities, or inductances might be, provided these did not vary with time.

If the wave of E. M. F. impressed upon the first transformer were not sinusoidal, then, with iron still excluded, there would be a progressive change of wave type accompanying the attenuation and phase displacement. The change would be rapid in the earlier, and more gradual in the more remote transformers. The finally surviving waves after an indefinitely great number of successive conversions, would be fundamental sinusoids, *i. e.*, simple harmonic waves of the alternation frequency. The exact rate at which deviations from the sinusoid are absorbed depends upon all the conditions of the successive circuits, but is open to computation when these data and the initial wave outline are forthcoming.

If, on the other hand, the induction coils contain iron, new considerations arise. There will now be hysteresis and variable magnetic leakage to take into account. Owing to hysteresis the currents will not be sinusoidal even if the first impressed E. M. F. be sinusoidal, and owing to this the drop of pressure in resistances will introduce a departure in the voltages from the simple harmonic type. The magnetic leakage which varies during the cycle also causes some deviation of a similar nature. But while this disintegrating influence is extending there will also be a correcting tendency at work such as would be established by transformers without iron. Which of these tendencies will preponderate, whether the waves would become more and more distorted along the series, or more nearly sinusoidal, would depend upon all the circumstances of the circuits, of the quality of iron in the cores, and of the initial wave outline, but under ordinary conditions it would seem that the waves would never become truly sinusoidal, but would also never undergo great distortion.

Briefly then, non-ferric induction coils would, in the permanent state, transmit an initial sinusoidal wave through an indefinitely long series of such coils, unchanged in type. They would also sift an initially non-sinusoidal wave down to a sinusoid, so that practically the conditions might then be closely represented by a sinusoidal generator of reduced amplitude brought into operation further along the line, beyond the principal sphere of shifting action. With ferric transformers the case would be more complex, but broadly, there would be a tendency for the sinusoid to survive.

1. See The Electrical Engineer, Dec. 6, p. 497.

SOME DATA ON CABLES FOR THE PACIFIC

BY

William J. Hancock

In all the phases of the Hawaiian question which is agitating so many minds, the submarine cable is certainly very conspicuous by its absence.

In a country such as the United States, which possesses the most extensive telegraph system in the world, so freely used by the public and press, it is somewhat striking to be suddenly brought back to the days when telegraph communication was in its infancy, and was still one of the wonders; the days when all communications had to be sent over the sea and to wait days, weeks and months for a reply.

This is the state that the Hawaiian question finds us in at present, and both countries have to wait long intervals before the one can communicate with and obtain a reply from the other. With telegraphic connection, doubtless the Hawaiian problem could be settled in as many hours as it takes weeks now. I think this case shows that telegraphic communication is indispensable in the management and administration of countries and peoples.

While the submarine cable is thus conspicuous by its absence, its existence in any other direction is equally conspicuous. By newspaper reports from Honolulu received by a steamer at San Francisco, the first news of President Cleveland's decision appears to have reached that place by telegraph to New Zealand and thence by steamer to Hawaii.

To reach these islands, which are about the nearest land in the Pacific to the United States (2,200 miles from San Francisco) the intelligence had to travel 19,123 miles by cable and wire, more than three-quarters round the world.

It may be interesting to trace the course of the cable to Australia and New Zealand. Below I give the figures in round numbers and the important points on the route.

The course across the Atlantic to London by one of the excellent cable companies varies to some extent.

The distance being about 3,800 total miles from London, it may then go by 3 routes, viz., Eastern Extension, Indo-European, or Siberia routes; the latter, however, is seldom used for these messages. Taking the Eastern Extension route the mileage is as follows :

	Land miles.	Cable.	Total.
New York to London (say) ..	1,000	2,800	3,800
London to Falmouth........	350	....	350
Falmouth to Gibraltar	....	1,061	1,061
Gibraltar to Malta.....	....	1,008	1,008
Malta to Alexandria	...	828	828
Alexandria to Suez	224	....	224
Suez to Aden...............	....	1,846	1,846
Aden to Bombay	....	1,662	1,662
Bombay to Madras..........	650	....	650
Madras to Penang..........	....	1,280	1,280
Penang to Singapore........	....	399	399
Singapore to Batavia........	....	553	553
Batavia to Banjoewangie...	480	....	480
Banjoewangie to Java, Port Darwin................	....	1,150	1,150
Port Darwin to Adelaide....	2,150	....	2,150
Adelaide to Sydney.........	900	....	900
Sydney to New Zealand.....	....	1,282	1,282
	5,754	13,369	19,123

The Australia main cable system consists of 2 cables between South Australia and Banjoewangie, Java. Then there is :—

1 cable between Roebuck Bay, Western Australia and Banjoewangie, Java; 2 between New South Wales and New Zealand; 1 between Victoria and Tasmania.

These are all the property of the Eastern Extension and China Telegraph Co.

The first cable connecting Australia, with the rest of the world was laid in October, 1871, from Banjoewangie, Java, to Port Darwin, South Australia, to meet the overland line crossing the heart of Australia from Adelaide to the South. The line was not opened until the 21st of October, 1872—horse expresses carrying the messages across the unfinished portion in the meantime. A second cable was laid over the same route in 1879. A serious interruption occurred on the 30th of June, 1888, when both cables suddenly ceased to work, the fault being found to be 220 miles from Java. This was caused by a violent volcanic and seismic disturbance destroying some miles of the cables It was not until the 18th of July, after 19 days of interruption, that communication was restored.

Subsequently a third cable was laid from the same place in Java to the Northwest Australian coast. This did not prevent another total interruption of all the cables by a cause similar to the former, cutting off communication for days. So long as the cables pass through this region of seismic disturbance around Java, so surely must total interruptions be expected. An alternative route across the Pacific has been proposed. This route would be less liable, I think, to interruption from volcanic disturbances, although Hawaii is a volcanic area. Such a cable would doubtless get a share of business. One of the proposed routes is as follows:

	Nauts.
Sandy Cape, Queensland, to New Caledonia........	740
New Caledonia to Fiji....................	740
Fiji to Samoa....................................	640
Samoa to Hawaii via Fanning Island..............	2.259
Hawaii to Vancouver, B. C.......	2,500
	6,879

The section between Queensland and New Caledonia has been completed and is open for traffic. The length of time taken by a message from Australia to London depends a good deal on the traffic from other countries coming in on the way. But the principal delay in obtaining a reply is caused by the difference of time, which is about 8 to 9 hours between Australia and London. It is easy to get a reply the next morning to a message sent in the evening, say 6 p. m. (which is about 9 a. m. London time), which is sufficient in most cases.

The Australian merchant when he finishes his day's work can send his telegram to London knowing that as he goes to bed the London merchant is just starting his day's work and has all day to deal with it. The London merchant having dealt with it can send off his reply and go to bed peacefully, knowing that the Australian merchant will receive it as he opens his office in the morning.

ELECTRIC TRANSPORTATION DEPARTMENT.

STORAGE BATTERIES FOR CENTRAL STATIONS.[1]

BY C. O. MAILLOUX.

Since the report was read at Milwaukee, the writer has discovered therein a mistake, which is partly accounted for, if not altogether excused, by the limited time in which it was prepared, it having been, in fact, mostly written on the way to Milwaukee, owing to the delay experienced in receiving the data requisite from various sources.

By an error in pointing off decimals, the cost of a 1,800 k. w. hour battery was wrongly given as $8,450 instead of $84,500. The saving figured out in that case, of course, vanished with the change, were it not for further corrections which can now properly be made, and which partly compensate this error. The abstracts of the paper, published by the technical press, have had the effect of waking up American battery manufacturers to a realizing sense of the importance of the results obtained in Europe, and of the necessity of their making efforts to prevent the European manufacturers from invading the field in this country. No less than three concerns have already informed the writer of their intention to immediately put large central station batteries on the market. In one case the writer was shown the plates in process of manufacture. The information obtained by the writer since the paper was read seems to show quite conclusively:

1st. That the cost of large central station batteries will not exceed $35.00 per kilowatt hour, set up, in most cases, and for smaller sizes will not exceed $50.00 per kilowatt hour.

2d. That the cost of maintenance will not exceed 10 per cent. of the initial cost.

3d. That the rate factor can be safely based on three hour discharge, or even less, in most cases, instead of four hour discharge as assumed in the paper.

If we make use of these amended data, we find that not only the cost per unit of battery capacity, but the total capacity itself can be reduced. In the case considered, the required capacity now becomes reduced to that determined by the *quantity factor*, instead of being determined by the *rate factor* (43 per cent. more); hence a battery of 910 k. w. hours capacity will be enough. This at $35.00 will cost $31,850. The interest (6 per cent.) and the maintenance (10 per cent.) will make the *annual cost* $5,096.00. This is equivalent (for 365 days) to $13.96 per day. As the coal saved, in this case, was calculated to be 4.47 tons, it follows that the use of the storage battery would only pay if coal cost over $3.15 per ton, instead of $1.10 as given in the paper.

1. An Appendix to a report on this subject read at the Twelfth Annual Meeting of the American Street Railway Association, October 18, 19 and 20, 1898.

THE COST OF ELECTRICITY ON THE CANALS.

BY E. T. BIRDSALL.

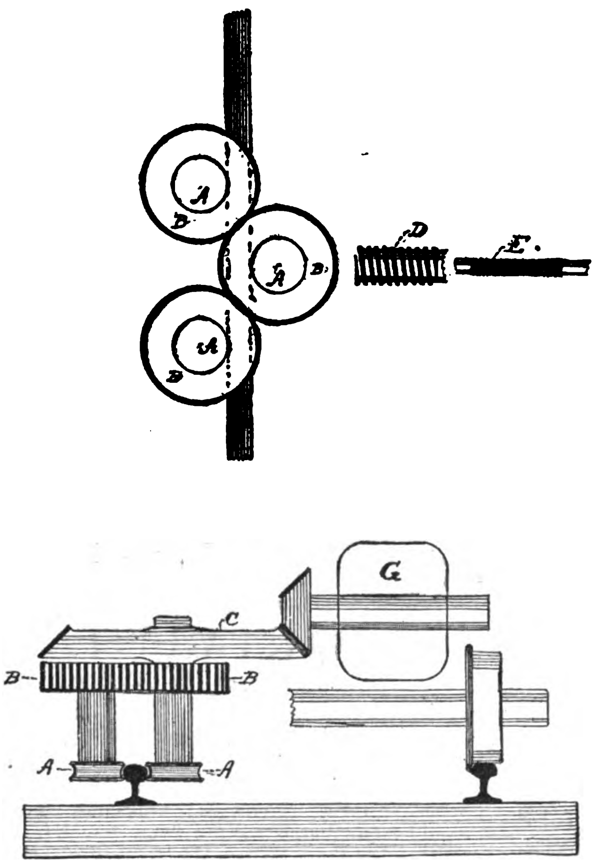
Judging from the editorial in The Electrical Engineer of December 6, it would seem that the State Engineer, Mr. Martin Schenck, does not take the same view of the problem of propelling canal boats with electricity that the enthusiasts at the trial did. Having gone over the possibilities of this matter some three years ago somewhat thoroughly, I am inclined to endorse his views. At the time mentioned I controlled a water power situated in the Mohawk Valley only half a mile from the canal and about one-third of the distance from one of its termini. This power has a minimum of 5,000 h. p. at all seasons of the year and can be developed at a minimum of outlay, yet we could not figure out a saving to the canal boatmen by the use of electric motors in place of the present engines.

The enemy of all power transmission schemes is cheap coal and in this case coal at $2.50 and $3.00 per ton gave the enterprise its death blow. I grant that the size of this plant would have been microscopic compared with the Niagara Power plant, but until reliable figures as to the cost of the power per horse-power at the Falls and the cost of erection and maintenance of the trolley line on the canal are given, I shall continue to be doubtful as to the commercial success of the plan. I do not question that boats can be propelled by electricity delivered from a pole line or that they can lessen the time of transit, but the question is, Will it pay a divident on the investment? This is the whole problem.

Again, is the automobile canal boat the best solution of the problem? I think not. This granted, we have either the locomotive on the tow-path or a similar motor placed overhead. The mechanical difficulties of both the latter methods multiply rapidly as we proceed to work out the details of the system, and while I cannot yet see daylight through the problem, I think that either of these plans will give a much lower cost per ton-mile than the one tried. If it is suggested that electric tugs would be a solution of Mr. Schenck's objections, there again comes up the question, Would not steam tugs do the work cheaper? Small compound condensing engines do not use much fuel and the interest on a pole line the length of the canal will buy a large amount of coal. Unfortunately I did not preserve the data and figures that I made on the cost of electric towing at the time mentioned as I was certain it could not be made a commercial success at that time. While high pressures and multiphase motors may help the matter some, yet the difference to be overcome is so great that in the absence of more reliable information and data, I think it will be well to restrain our enthusiasm until we have something more tangible to enthuse over.

DAVIS' ELECTRIC CANAL BOAT TOWING SYSTEM.

AMONG those in attendance upon the Canal Conference held in this city on December 5, was Mr. T. D. Davis, of Syracuse, N. Y., who brought with him plans of a system for towing canal boats by means of an electric locomotive running on the bank. The idea possesses many novel features which will be readily understood by reference to the accompanying illustrations.



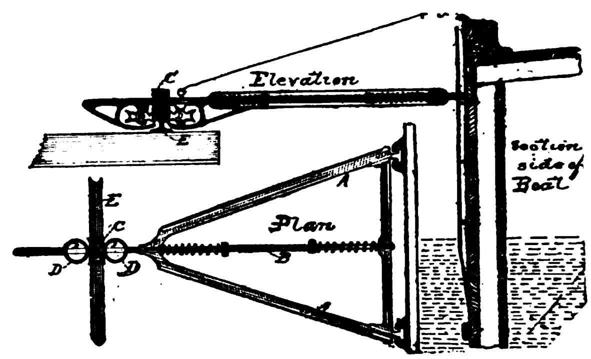
FIGS. 1 AND 2.—DAVIS' ELECTRIC CANAL BOAT TOWING SYSTEM.

The plan contemplates the laying a narrow gauge rail-track on each bank of the canal and moving the boats in trains or tows of four or six boats each by means of a small car furnished with a device for gripping the rail, to be driven by an electric motor from an overhead trolley line. The boats are connected with the inner rail, laid near the water's edge, and require no steering. In some of the larger cities on the line of the canal where it might be impossible to lay a track on the berm bank a double track may be laid on the tow-path and the outside tows steered as they now are.

Figs. 1 and 2 show the principle of the device for towing the boats. A A A are three horizontal wheels secured to vertical shafts carrying on their upper ends three cog wheels B B B, by which they are geared together, and all have a uniform speed. Two of the wheels A are on one side of the rail. The third wheel is placed in a movable frame on the opposite side and is forced against the rail by the spring D surrounding a shaft on one end of which is a threaded extension E, connected by gearing with a hand wheel within easy reach of the motorman. The object of this is to secure an elastic grip of any desired pressure of the wheels on the rail. The shaft of one of the wheels A extends above the cog wheel B and is provided with a bevel wheel C which is driven by the motor G; the whole carried on a small platform car and driven by a trolley connection. This device insures a positive grip on the rail and utilizes the entire amount of power received from the motor, with the exception of a small amount of loss by unavoidable friction.

Fig. 3 shows a light triangular wooden frame. This is provided at its wide end with a pair of T-hinges by which it is connected to the side of a boat as shown at Fig. 4. A pair of slotted irons about four feet long, secured to the side of the boat, have their upper end open for the reception of the T-hinges which are secured at any desired height by pins. This frame is provided with an iron bar B moving freely in the frame and provided near its outer end with three small wheels; one vertical wheel C rolling on the top of the rail E carrying the weight of the free portion of the frame, and the two horizontal wheels D D rolling one on each side of the rail.

The bar B is provided with two spiral springs as shown and also with an extension or guard at its extreme end. The spring will compensate for any sudden jar or movement of the boat, thus relieving the boat and rail and securing an elastic, instead of a rigid connection.



FIGS. 3 AND 4.—DAVIS' ELECTRIC CANAL BOAT TOWING SYSTEM.

When a boat enters a lock the free end of the frame A is raised by a lanyard and turned over on the deck as shown by the boat leaving the lock at the left of Fig. 5.

The time now required to lock a loaded boat down is about ten minutes, to which is to be added five minutes for changing the lock for the next boat. At this rate 111 boats can be locked through in 24 hours. Mr. Davis estimates that with a lock provided with electric equipments and the boats delivered at the entrance of the lock in good shape, that is, in perfect line with the lock, for which this system provides, the time can be reduced to about 7½ minutes each, at which rate 200 boats can be locked through in 24 hours, showing that with the locks worked to their full capacity 40,000 boats can be locked through the canal each way in a season of 200 days.

It is estimated that the cost of operation by this method would amount to about one-tenth of that of the present system of towing by horses.

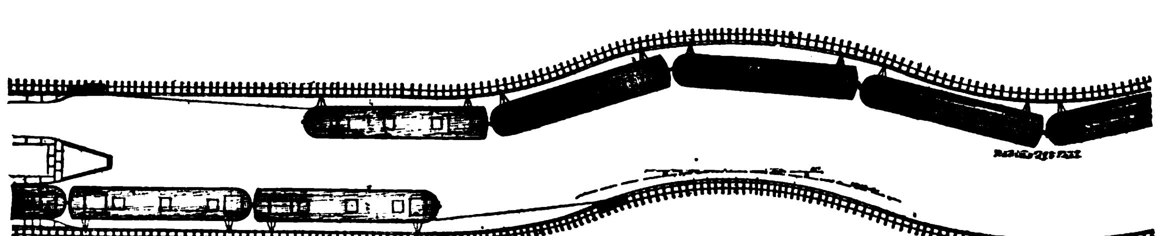


FIG. 5.—DAVIS' ELECTRIC CANAL BOAT TOWING SYSTEM—BOATS LEAVING AND ENTERING LOCK.

ELECTRIC REFUSE CARTS FOR BOSTON.

A STREET cleaning contractor in Boston suggests that early every morning, large cars built after the fashion of the gravel cars run on steam roads be sent over all the lines of the electric railways, and garbage and refuse, gathered along the way be shoveled into them. Following these cars would come large watering cars able to wet down the streets from curb to curb. The advantages of this system over the present one of carting off refuse and dragging watering carts by horses are that it is cleaner and faster. There would be no waiting for carts to go off and unload, and an item of saving would be in the reduction of the number of men needed, as, under the electric system, it is estimated that the work of street cleaning could be easily done by two-thirds of the number now employed.

MISCELLANEOUS.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.[1]—I.

INTRODUCTORY.

THE utilization of the Falls of Niagara has long been a favorite theme of engineers, but it was not until the transfer of power by electricity became feasible that this could enter very satisfactorily into the region of practical engineering. The matter is now in the hands of one of the most powerful combinations of New York capitalists which has ever been formed. Under their auspices the matter was, for the first time, thoroughly investigated from an engineering, financial and commercial point of view. Rights were then acquired, and companies formed. The Cataract Construction Company does the engineering work, and will then hand it over to the Niagara Falls Power Company. The Land Development Company builds a whole village on the extensive lands acquired. The Niagara Junction Railway Company constructs six miles of terminal railway to connect all the factories, as they are built, with the railways in the neighborhood. Rights of way are obtained in many directions, and also over the Erie Canal, which connects the Niagara and Hudson Rivers. Allied companies are formed to develop power to all the cities within reach. Roads are made, leases of land granted, factories built, and the engineering works taken in hand by the Cataract Construction Company. It is with this latter that we have chiefly to deal. Mr. E. D. Adams is the president, Mr. F. L. Stetson the first vice-president, and Mr. E. A. Wickes second vice-president; Mr. W. B. Rankine is secretary and treasurer; Mr. G. B. Burbank is the chief engineer; and Dr. Coleman Sellers acts both as consulting engineer to the Cataract Construction Company and president of the Niagara Falls Power Company, while undertaking at the same time many of the duties of resident engineer. The waters from the river are taken in at a point about a mile and a half above the Falls by a canal, from which it is led, by channels, into a long slot in the ground, going to the depth of 200 ft. In this slot are iron pipes, or flumes, down which the water is carried to the turbines, and the waste water is carried through a tunnel for a distance of 7,000 ft. to a point a few hundred yards below the American Falls, where it discharges into the lower river. Each turbine is of 5,000 h. p., revolves at a speed of 250 revolutions per minute, and is mounted on a vertical shaft. Above it there is a shaft extending in a vertical direction to the surface of the ground, on which a power house is built, and the revolving part of the dynamo is placed directly upon the top of this shaft.

RELATIVE ADVANTAGES OF DIRECT AND ALTERNATING CURRENTS.

One of the chief difficulties in connection with using the direct current is that it is necessary for getting the best results, to connect a number of dynamos in series, and also to put the motors at the receiving end in series with each other. This involves the insulation of each dynamo and motor from the earth—a requirement which can in some cases be attained, but which in a general system of distribution is apt to be attended with difficulty, and perhaps with danger. The best case of the kind which has been put in practice is that of Genoa, and we gave it the most serious attention, but came to the conclusion that, for our purpose, it was undesirable.

The facility which the stationary transformers used with the alternating current give for varying the pressure according to the requirements of economy or safety, is one great feature in favor of the alternating current. The question was considered in all its bearings with the utmost care, and it was not until the month of May, 1893, that the Board of Directors passed the resolution to adopt the alternating current both for their distant transmission and also for the works nearer to the power house. It was proposed, indeed, by some manufacturers to distribute the current within a radius of a mile or two at 700 or 800 volts, and one firm proposed to do this by means of a direct current. Had this plan been accepted, we would have arrived at the surprising result that by using the continuous current at 700 volts within a mile or two, and high-pressure alternating current for more distant places, it would have cost more to produce a horse-power per annum at Niagara Falls than at Buffalo.

The argument that seemed to me the most important in favor of using the direct current was, that motors for this purpose have been made in much larger quantities than alternators, and that it would be seldom necessary to build special types of machines to act as motors. This advantage seemed to be of great importance, until I realized the value of a low frequency used with the alternating current. So soon as we reduce the frequency low enough, we are able to alter a direct-current motor into a synchronizing alternating motor, by the simple addition of a couple of rings placed on the commutator and electrically connected with opposite bars of the commutator, and a brush rubbing on each of these collecting rings. I also took into consideration the question of the possibility of storing up energy in storage batteries during the night-time, when, of course, the demands on our plant would be least, and giving it off during the daytime; but at the present time the cost of the batteries would not repay work in this direction, and it would be cheaper to make another tunnel, with wheel pits, turbines, and all the paraphernalia required to generate current than to go to the expense of putting down the large amount of lead which is required for these batteries. With the alternating current we have the choice of a considerable number of motors of different types. We have the synchronizing motor, the series-wound motor with laminated field and commutator, the multiphase motors, which attracted so much attention at the Frankfort Exhibition of 1891, and a host of single-phase motors which have been developed by various inventors, but which have never been placed on the market because of the high frequency which has been prevalent, and with which they were not altogether satisfied. These motors become immediately available if we use a lower frequency. The generation of an alternating current also permits of the use of a commutator, or rectifier, with direct-current motors.

NUMBER OF PHASES.

Assuming now that it is generally agreed that the alternating current must be adopted, not only for the distant transmission, but also for the nearer work, the next point to consider is the number of phases—whether the current should be generated in a single phase, in two phases or in three phases. The possibility, too, of using even a greater number of phases was also considered, but it did not seem to possess advantages.

As already stated, there are many motors which are suitable for use with a single phase at low frequency, and which start without assistance. In the workshops of nearly all the most able electricians which I have visited in the course of the last year or two I have found such motors built upon different plans, and nearly all of them seemed to work fairly well, and promise to be very efficient at low frequency.

For all heavy work, which is going on constantly without stopping the machinery, no motor could be more suitable than the synchronizing alternator on a single phase, and its speed is as regular as that of the turbine which is developing the power. It seems, however, that even if single-phase motors are going to be adopted, it would be best for the generator to have two phases, because in this way we get a larger output for the same size and price of machine: the circuits may be perfectly independent, and supply separate motors. Also, the two-phase system makes the rectification or commutation of the current more easy to use it for street railways, electro-metallurgy, etc. Again, multiphase motors have a great advantage in that they have been considerably utilized already, and even in small sizes have a fairly good efficiency.

With regard to the relative merits of two and three phases, several claims that cannot be supported have been put forward in favor of the latter. First, it is claimed that the saving in the copper on the line is 25 per cent. over a one-phase system, and 25 or 18 per cent. over a two-phase system, according as four or three wires are used for the purpose. I investigated this matter carefully, and arrived at the conclusion that this was not the case, and that the three-phase system had no advantage in this respect over a two-phase system with three wires. Second, it is claimed that there is a greater simplicity of wiring with three phases than with two phases; but this advantage disappears when we remember that the two-phase system can be used with only three wires, although this is not a plan which I would recommend. Third, it is claimed that any pair of the three wires may be used for a distribution of lighting. This is not the case. A two-phase system, where the circuits are completely independent, is much more suitable for the purpose, and maintains the lights at a more constant electric pressure. Fourth, it is claimed that there is a smoother starting and rotating effort with the three-phase than with the two-phase system. This was originally claimed on theoretical reasons only by Dobrowolsky, but everyone who has used the type of two or three-phase motors made by the Oerlikon Company, by C. E. L. Brown, and by the Allgemeine Electricitäts Gesellschaft, of Berlin, and others, is convinced that this advantage, which seems probable enough, is purely theoretical; it is not confirmed by actual practice, and, moreover, when the fact is known, the theoretical reason is pretty evident.

No other claims in favor of the three-phase system over the two-phase have ever, to my knowledge, been advanced; and, as shown above, a very full consideration of these claims does not tell in favor of the three-phase.

I will now point out what seemed to me great objections against the three phases, due to the fact that the three conductors are all inter-connected. First, it introduces trouble in maintaining the efficient working of the line, and in testing it; so that a higher type of electrician would be required to make these tests, and even he would have greater difficulty in finding the faults and correcting them. Secondly, when the three circuits are unequally loaded, the electric pressure varies considerably. These difficulties have been thoroughly appreciated by workers in this line. When an

1. Abstract of a paper read by Prof. George Forbes, before the Institution of Electrical Engineers, London.

inter-connected set of circuits such as the three-phase system employs is used, it is found that when the circuits are unequally loaded there are great variations in the electric pressure, and the following tests were made at my request to illustrate this. The three circuits are called A, B and C. The average electric pressure of the three branches at the terminals of the secondaries was maintained constant. A resistance tending to reduce the electric pressure at the lamps 5.3 per cent. was introduced into each branch. Both the primaries and the secondaries were connected as represented by the form of the letter Y. By varying the connections in different ways, some light variations were possible; but this general fact remained—that when A is loaded and B and C are not loaded, the pressure of A is less than that of C, and that of C is less than that of B, and the difference may be 12 or 13 per cent.; and when A and B are loaded and C is not loaded, the pressure of A is less than that of B, and that of B is less than that of C. The variations here shown in the pressure of two equally loaded circuits, is probably due to the armature reactions, and would be found in a two-phase system also; but the rest of the variation is due to the inter-connection of the three circuits, and is an obvious defect of the three-phase system. In order to get over this difficulty, the Oerlikon Company proposed to devote only one circuit to lighting purposes, which shall be maintained at constant pressure, using the other two circuits for power purposes, where constancy of pressure is not so important. In some cases this would be a suitable method of working, but it was not considered satisfactory for the work at Niagara Falls. Having considered these points, the Board of Directors of the Cataract Construction Company, at their meeting in May, 1893, determined to reject the three-phase system, leaving the single-phase and the two-phase available.

Conditions	Volts of Terminals of Lamp Mains				Difference between Maximum and Minimum Volts.
	A.	B.	C.	Avrge.	
A, B and C loaded (resistance out).	108.5	108.6	107.9	108.3	0.7
A, B and C loaded (resistance in) ..	103.5	103.6	103 2	103.4	0.4
A loaded, B and C off..............	102.9	116 0	108.5	108.5	13.1
B loaded, A and C off..............	104 5	102 5	114.9	107.3	12.4
C loaded, A and B off..............	115.1	105.3	101.3	107 2	13.8
A, B and C loaded (resistance in)...	103.0	103.4	102.5	103 9	0.9
A and B loaded, C off......... ...	98 9	107.8	111.1	105.9	12.2
A and C loaded, B off..............	101.2	108 0	98 1	102.4	9.9
B and C loaded, A off..............	110.5	98.0	105.8	104.8	12.5
A, B and C loaded (resistance in) ..	103.7	103.0	103.0	103.5	0.7

FREQUENCY OF ALTERNATIONS.

I wish now to say some words on a question which has absorbed my most serious attention, especially since I have been acting for the Cataract Construction Company, and this relates to the frequency of the alternating current. In America a frequency has generally been adopted of 133 complete periods per second for lighting purposes. This was done with the object of reducing the cost of transformers, which were supplied to each separate house, and consequently were always of small size, and therefore expensive. The selection was also approved because American engineers working with alternating currents have generally put forward the view that parallel work is not desirable, and the fact that parallel working is more difficult at high frequency, which is one of the principal objections to high frequency, has not been seriously considered in America. In Europe the usual frequencies are from 70 to 100 periods per second, but a notable exception exists in the case of Messrs. Ganz & Co., of Buda-Pesth, who have adopted 42 periods per second. Some years ago I unwittingly did Messrs. Ganz the injustice to say that I thought it probable that they had adopted this frequency because it suited their particular type of machinery and speed of running. I have it in writing from them and I am thoroughly convinced of the truth of it, that their reason for adopting the frequency of 42 periods per second was that it is the lowest frequency that is available with arc lights so as not to produce any serious flickering, and their desire was to lower the frequency as far as practicable in order to ensure parallel working. Of course, it is a matter of common knowledge that parallel working is assisted by lowering the frequency.

With the large units which will be employed in connection with the Niagara Falls scheme, the cost of the transformers is very much diminished; and this does not become so important a matter as it does when all the transformers are of small size—under 10 h. p., as is usual in electric lighting in America. Moreover, although with lower frequency the transformers must be increased in size, the increased cost is not in proportion to the lowering in frequency, because we can use a higher induction. Mr. Steinmetz has shown that the loss due to hysteresis varies as the induction raised to the power 1.6, and it is this loss which must be kept constant when we vary the frequency. I deduce from this law the fact that in any transformer, if the hysteresis loss is kept constant, its power of doing work varies in proportion to the frequency raised to the power 0.4 (but it is probably unwise to increase the induction so much as to saturate the iron). It follows that when we double the frequency we get out of the same transformer 132 units of work instead of 100. If the frequency were quadrupled we should get 174 units instead of 100. I have been informed by Mr. William Stanley, Jr., of Pittsfield, Mass., that without the use of theory, but simply working from his experience in manufacturing and testing transformers, he obtains almost identically the same law; and I have got independent practical testimony in the same direction from other manufacturers. It appears, then, that there can be no doubt that in lowering the frequency we are not proportionately increasing the cost; but at the same time it must be realized that the cost of transformers is to a certain extent increased by lowering the frequency. If the frequency be reduced to one-half, the cost is increased about 50 per cent. The lowest price which has been quoted for large transformers is $3.52 per horse power, at a frequency of 42 periods per second. In halving the frequency the extra cost would therefore only be $1.76 per horse power. It becomes, then, a matter of inquiry whether the benefits to be derived by lowering the frequency in such a proportion would compensate for the extra expenditure as indicated. I am thoroughly convinced that the gain is far in excess of this amount. I shall have occasion to discuss the superior efficiency of motors at low frequency; and in most types of motors I think it safe to say that in passing from 42 periods to 21 periods, or varying the frequency in that proportion, we have a gain of at least 3 per cent. in the efficiency of the motors. Neglecting altogether the increased value of the motors from this cause, there is 3 per cent. more power at our disposal, which, at only $10 per horse power per annum, would amount to 30 cents per annum, or, capitalized at 5 per cent. represents an increased value of $6 per horse power of the plant, against which have the increased cost of transformers—only $1.76. It appears, then, pretty certain that, from a purely economical consideration of the question, a lower frequency than any which has hitherto been adopted is advantageous.

With regard to the lowest limits at which we can work, since our turbines have been designed to revolve at 250 revolutions per minute, a two-poled dynamo—if such could be satisfactorily constructed—would give a frequency of $4\frac{1}{6}$ periods per second, and none of the synchronizing or polyphase motors employed at different factories could run at a higher speed than 250 revolutions. I am not sure that it is desirable that any motors should run at a higher speed than this, but in the few cases where this might be desirable the use of belts would be quite natural in order to give the higher speed. With a four-pole machine we would have a choice of speeds at 500 revolutions, 250 revolutions, and any submultiple of these speeds, for by increasing the number of poles in the motor the speed of the motor can be reduced as much as we please. With eight poles in the generator the maximum speed is 1,000 revolutions per minute, which is as high a speed as would generally be desired in connection with the factories supplied from Niagara Falls. This frequency is $16\frac{2}{3}$ periods per second; and after considering the three points—namely, cost of transformers, speed of synchronizing motors, and convenience in the design of the generators—I came to the conclusion that, so far as motive power was concerned, this is the frequency which would be most favorable for use at Niagara Falls.

Another indirect advantage of using a low frequency is of a very practical nature, and lies in the fact that the ordinary continuous current dynamos of any size that are made may be used as synchronizing motors by means of rings attached to the commutator bars in the manner which has been above described. This method of altering and working a direct-current motor so as to make it suitable for an alternating current of low frequency, has long been known to electricians, but the attention of those who are not experts was forcibly directed to it by the machines shown by Mr. Schuckert and others at the Frankfort Exhibition in 1891. Owing to this fact, it would be possible for any manufacturer connected with our supply station to procure a motor of low frequency of any moderate power he might require at a day's notice; and this is not true of any other alternating motor, nor is it true of a higher frequency.

ELECTRIC COMMUNICATION WITH LIGHT SHIPS.

Among the estimates submitted to Congress lately there is an item of $50,000 for establishing electric communication between lightships and the shore. A note accompanying the estimate says:

"The House of Representatives committee on international and foreign commerce on December 6, 1892, asked the views of the Treasury Department as to the bill appropriating $50,000 to provide communication from lightships and outlying light houses to the shore. Favorable reply was made on December 8, 1892. Since then the lighthouse board has experimented, and is now satisfied that it can establish electric communication between lightships and shore. It is proposed to commence with an important lightship quite near shore, then take a more important one more distant, and then, if need be, another still further away, and thus acquire by successive effort the experience needed to successfully lay an electric cable to connect with the shore the most distant and important lightship, that on the New South Shoals, some thirty miles off Nantucket, Mass."

THE STORAGE BATTERY QUESTION.[1]

BY PEDRO G. SALOM.

THE speaker began by calling attention to the fact that, notwithstanding the unfortunate effect of litigation during the last five years, interest in storage batteries is greater now than ever before. He then gave a brief *résumé* of storage battery history. The main difficulty with the Planté battery is that there is not a sufficient amount of metallic conductor for the current to properly distribute itself with respect to the electrolytic reactions that must take place in recharging. This would render its commercial use impossible, even if this were the only fault. If its principle were true a plate of peroxide and a mass of spongy lead would give us an ideal battery, but on account of the sulphating this is impossible. The Brush-Faure battery was then touched upon, and the method of manufacture described, after which the speaker went into the detail of the chemical reactions taking place during their operation, and called attention to the fact that a pound of zinc burned to oxide of zinc or a pound of lead burned on a grate or in the open air to oxide of lead, produced the same mechanical equivalent in foot pounds as it would if consumed in a battery and developing current.

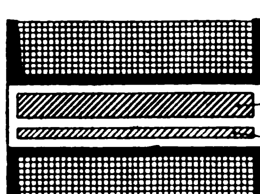
The various applications of the storage battery were then considered. The expense per annum of maintaining a battery for lighting was about 25 per cent. of its first cost. At the same time it was so essential to a first-class lighting station and its use was so rapidly increasing that the first cost would probably be greatly reduced before long and the cost of maintenance would perhaps reach the low figure of 5 per cent. per annum. The advantages of "combination plants," *i. e.*, generators and accumulators in the same central station, were strongly urged. Turning to storage battery traction the speaker predicted that it would ultimately entirely supersede the trolley for street car service.

Electric launches were also briefly mentioned and the application of storage batteries to small boats referred to as literally ideal in its way, and a number of the more important of the minor uses of accumulators were mentioned. The speaker said in conclusion that storage batteries were destined to play an ever-increasing part and that a conscientious study of their principles and applications would repay the efforts of the best electrical talent.

COMPENSATION FOR HYSTERESIS.

MR. E. B. VIGNOLES, in an article in the London *Electrician*, of November 3, speaks of the drawbacks to the use of a magnetic measuring instrument containing iron on account of the liability to errors due to hysteresis.

It is, perhaps, not generally known, he writes, that by an ingenious device due to Mr. Evershed originally, and for which a provisional specification was filed some years ago, the effects of hysteresis can be almost entirely eliminated, and can easily be rendered so small as to be practically negligible. A similar principle appears to have been recently invented by M. Abdank Abakanowicz, whose methods are described in *La Lumière Électrique* and other papers. The simplest form of the Evershed method is illustrated by the accompanying engraving, which represents a section of coil magnetizing the iron cores I and C. Suppose the current tends to make the the left side north, and suppose that C is made of hard steel, and has, therefore, a much greater coercive force than the soft iron I. When the current is cut off the core C remains more intensely magnetized than I, and the return



EVERSHED APPARATUS TO COMPENSATE FOR HYSTERESIS.

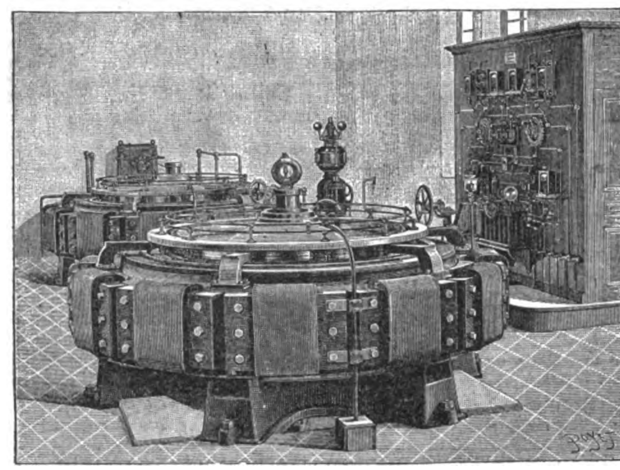
path for its induction in partly through I, which is thus demagnetized, and may be reversed. By suitably proportioning the parts the effect outside the core may be entirely obliterated.

Modifications of the method easily suggest themselves. The core C may be outside the coil, and separately magnetized, although this is generally more cumbersome; but it is needless to go into details, as the principle is so very simple; but one of M. Abakanowicz's examples is worth alluding to. He makes a wattmeter whose field is produced by two electromagnets, the main core producing a large field in one direction, and a small and very coercive core producing a small reverse field, The "residual magnetism" of the two may be easily made equal, while when the current is on, the main field is largely in excess of that of the compensator.

The condition for perfect compensation is that the two curves of magnetization shall be similar, but on different scales; but the author has found that this condition is exceedingly difficult to obtain. It is possible that for standard instruments the method may be of value, but the author believes that Mr. Evershed had not kept up his patent. It is probable, he thinks, that compensation would never be so perfect as to obviate entirely the necessity for the precautions above described.

THE SALEVE ELECTRIC RACK RAILWAY.[1]

AMONG the best frequented resorts surrounding Geneva is Salêve to which an electric rack railroad has been built, which has been in successful operation since Dec. 1, 1892. The motive power is obtained from the River Arve. The station is equipped with three vertical 250 h. p. turbines, which owing to the fact that the fall of water is about ten feet revolves at only 45 revolutions per minute. The shafts of these turbines carry the horizontal armatures of the dynamos shown in the accompanying engraving. These machines, built by Thury, are nearly 11 ft. in diameter and weigh 19 tons each. The armature has twelve poles and is able to furnish 275 amperes at 600 volts. In ordinary operation one car, running at the speed of 3¾ miles per hour takes between 40 and 100 amperes at from 530 to 550 volts.



THURY RAILWAY PLANT, SALEVE.

From the power station the current is led by overhead conductors to the railroad station at Monnetier-Mairie. From this point out one of the conductors is connected to a large insulated conductor placed on the left side, and running the whole length of the track, at a height of eight inches above the rail. This conductor is carried on brackets bolted to the cross ties and well insulated by means of heavy porcelain bells. The conductor is of the same shape and material as the rails; the joints are all bridged by copper expansion strips, and brushes placed under the car slide on the upper part of the rail; the rails under the wheels constitute the return circuit which is connected to the other end of the aerial circuit at the car station. The loss in the line is 15 per cent. The cross ties are placed one yard apart and are of steel, as are also the rails which weigh 35 pounds per yard. The length of the railroad from Etrembières to Treize-Arbres is 3¼ miles, and the difference in level between the two depots is 2,280 ft. Grades of 16 and 25 per cent. are encountered with curves of 155 ft. radius. The car carries a small tank for sprinkling the brake shoes automatically to prevent them from overheating during the descent.

The cars are able to seat thirty-two passengers with standing room for eight more. Each car is provided with two Thury motors of 30 h. p. each. A conductor and a motorman are on duty at each end of the car; the conductor having charge of the switches and resistances with his eye fixed on the amperemeter, and the motorman watching the rack. In addition two additional brakes are within easy reach of each employé; absolute safety appears thus to be assured. The entire electrical material of this railroad was constructed and installed by the Compagnie de l'Industrie Electrique, of Geneva.

A CORPORATION WITH A SOUL.

The Canton-Massillon Electric Railway Co. donated the gross earnings of the road on Thanksgiving Day to the Associated Charities of the two cities.

1. Abstract of a lecture delivered before the Franklin Institute.

1. *L'Industrie Electrique.*

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THE NIAGARA PROJECT.

AFTER many months of expectancy, the electrical fraternity has at last been put in possession of the electrical details of the great undertaking at Niagara, which justly takes rank among the most important engineering projects of the century. These details have been given in the paper read by Prof. George Forbes before the London Institution of Electrical Engineers, and an extended report of which is begun in the present number of the ENGINEER. It was hardly to be expected that the promoters of the Niagara enterprise would accept the individual opinion of any one man on the various points of paramount importance which had to be considered, and Prof. Forbes' paper may therefore be looked upon as a fair representation of the views of the most advanced electrical engineers, as well as the results of Prof. Forbes' own careful study of the literature on the subject, and information gained from other sources. The paper may thus be considered not less an expression of the author's personal opinion than an epitome of the views of a large number of prominent electrical and mechanical engineers, and as such it will be of interest to determine in how far these views have been applied at Niagara. After a short historical account of the enterprise, Prof. Forbes enters into a comparison of the relative advantages of direct and alternating currents. While, in the main, we consider the views expressed and the reasons given for the course pursued to be consistent, there are some points which, it seems to us, have not been brought out prominently enough. Prof. Forbes for instance points out the advantages claimed for the direct current system and says that these advantages appeared to be of great importance until he realized the advantages of the low frequency alternating current. It will hardly be deemed unjust to Prof. Forbes if we advert to the fact that the advantages of low frequency were long since realized by a number of engineers, and it might also be worth pointing out that Mr. Tesla from the very beginning advocated the use of very low frequency currents, and employed them in his earliest motors; but the conditions obtaining in actual practice at that time forced him to the use of high frequency.

Among the types of synchronizing motors mentioned by Prof. Forbes which can be successfully operated with such low frequency currents is the series wound motor with laminated fields and a commutator. We cannot fully agree with him in regard to this type of machine. It has to our knowledge been thoroughly tested by the most prominent engineers and has thus far been found altogether wanting in respect to efficiency and output, as well as in reliability of operation. While the efficiency may be brought up to 75 per cent. in small sizes, it regulates very poorly and the sparking at the commutator is very troublesome. Again, contrary to the rule applying to ordinary machines, the larger the size of machine of this type the worse it shows up. To use such a type in the present advanced state of the art, when other, more perfect, types exist would be a decided step backward, and therefore hardly to be recommended. A much better way would be to run an ordinary motor on an ordinary circuit of low frequency and to provide the armature with sliding rings for conveying the alternating current, and to energize the field with the direct current. This type of motor is capable of high efficiency; but here again practice has shown that it is disadvantageous to excite the motor from the currents derived from the armature itself; and better results in efficiency and output are obtained by employing an independent source of direct current.

Prof. Forbes discusses the relative advantages of the two- and three-phase system as compared with the single phase, but has not brought out as prominently as he might have done, the advantages of the multiphase over the single phase. It is true that a single-phase motor of the the type mentioned above, that is, one with constant current field excitation,—is capable of giving very high efficiency, but the output at varying loads is hardly more than half that of a two-phase motor of equal weight. Theoretically the two-phase motor ought not to have a greater advantage than 40 per cent. in output for a given weight, and with a somewhat increased efficiency; but it is a fact that a two-phase motor of this kind will carry an overload greater than twice that of a single-phase motor and will "pick up" when the load is taken off, whereas the single-phase motor is easily thrown out of synchronism and may become a source of trouble for the entire plant. Of course, the rotating part of the single phase motor may be made very heavy, which would enable the motor to keep better in synchronism, but then it becomes very difficult to start and requires time for that purpose, and in practice it is of advantage to keep down the weight of the rotating parts as much as possible. We might also draw attention to the fact that the regulation of the current is poorer with single phase than with multiphase working, and furthermore, while cast fields can be used successfully with multiphase currents, they are very wasteful with single-phase. From this it results that it is much cheaper for the manufacturer as well as for the consumer to use a machine of the multi-

phase type in which the energy is supplied in a continuous manner and not intermittently. Of all the advantages, however, we consider that safety and reliability of operation are the things which would lead to the general adoption of multiphase apparatus. In a two-phase motor, for instance, one has actually two machines, and, with one circuit cut-off, the machine is still capable of developing a large fraction of its nominal power, while at the same time it is self starting. This advantage of the two- and three-phase in case of a breakdown is not brought out by Prof. Forbes. Besides, when the cost of construction is considered, the two-phase machine is preferable as it is simpler, and the coils may be more perfectly insulated; but whether two- or three-phase be used, the single-phase, so far as our present knowledge goes, could not compete with either of them in the long run, every thing considered.

The low frequency of 25 per second, of course, will enable ordinary direct current motors with the slight addition of two collector rings or other insignficant modification, to be run from the circuit efficiently, and in this respect it would have been perhaps desirable to have the frequency much lower still. Prof. Forbes mentions as a type of such machines those which were shown by Schuckert & Co., at the Frankfort Electrical Exhibition in 1891. But identical machines were shown in this country by Mr. Tesla at a much earlier date.

As regards parallel working, Prof. Forbes assumes the difficulties to be greater than they really are. There are a number of plants in this country working in parallel, and successfully so, in spite of the higher frequency. Mr. Mordey has had even greater success in England. It is unqestionably true that the lower the frequency, the easier may the machines be worked in parallel; but when the machine is of a very efficient type and the armature possesses extremely low self-induction, as in the case of the Mordey alternators, there is no great difficulty in working alternators in parallel. Where such difficulties have been found they are probably due to high self-induction and the heavy reaction of the armature on the field.

Prof. Forbes mentions the advantages of the motor-transformer or dynamotor of the two-phase type for canal boat propulsion and in other cases where a direct current is required. These machines are evidently well adapted for such purposes, work with high efficiency, and will probably find considerable employment in the future. Many engineers, however, are still skeptical as to the use of a commutator independently revolved, especially when a single alternating current is used, and, in general, where heavy currents would be required, as for instance in the electro-metallurgical work contemplated at Niagara. But even with multiphase working, although commutation is easier, the apparatus becomes complicated and sparking cannot easily be avoided, whereas with a rotating transformer there is no difficulty in this respect.

In discussing the size of conductors and the drop in pressure to Buffalo, Prof. Forbes seems to apprehend that there will be considerable retardation of phase which, he says, is an unknown quantity, and he calculates on an appreciably increased amount of metal. We trust that his fears on this score are exaggerated, since the difference of phase of current and E. M. F. in the dynamo adopted and motors of the identical type is very small. Moreover, if we assume, for instance, the transmission to a distance like Buffalo to be effected by motor transformers placed at Buffalo, the speed of such motors would remain perfectly unaltered even with wide variations of current in the line. This indeed is one of the chief advantages of such a method of transmission.

In regard to the potentials adopted at Niagara, we think it would not be advisable to connect the coils of the alternators for any much greater potential than 2,000 volts, the results of practice having clearly proved that it is better to use step-up transformers and a low potential dynamo rather than to wind the dynamo itself for high potential. This is truer at the present time than it ever was, now that transformers have been brought to such a high state of perfection and the cost per horse power so much reduced over what it was only a few years ago. As to the potential on the long-distance line we would like to have seen a higher voltage than 20,000 tried, but considering that reliability is the all-important factor here, the conservative views adopted and to be carried out are to be commended in an undertaking of such importance.

We do not doubt that the Niagara enterprise will be a technical success especially when we know that with it are associated such men as Dr. Coleman Sellers and Mr. Albert Schmid, who have, each in his line, such vast experience and skill. Prof. Forbes' paper is full of interesting data and experiences and will repay the most careful study.

A NEW DAY IN ELECTRICAL MANUFACTURING.

THERE is much food for thought in the determination of the Walker Manufacturing Company, of Cleveland, O., to begin the manufacture of electrical apparatus for light and power, and especially for electric railway work. This concern is one of the largest of its class and has a splendidly equipped establishment. Everybody who studies the situation knows that in America the cable industry has seen its largest growth and that electric railway work is but just beginning. At such a juncture, the Walker Company takes a bold but prudent step. We have good reason for saying that it enjoys the advice and assistance of some of the shrewdest men who have been connected with electric railway equipment.

With this news we may as well give the similar intelligence that the Ides, the engine builders of Springfield, Ill., have secured the plant of the defunct National Electric Manufacturing Company, and that they, too, will be in the field to supply apparatus. Such things are very significant. The old days of mystery and secrecy in electrical manufacture are happily gone forever and will not be seen again. A good patent will still be worth having, but companies will depend less on fundamental claims and more on fundamental merit. We have often expressed the belief that the huge litigations into which the electrical companies have gone have not been worth the fighting so long as business was hindered and the very things that were fought for were allowed to lie neglected and undeveloped. We could name engine builders in the foremost rank of reputation and excellence who have all their inventions covered by patent, and who, finding themselves assailed with infringements, have simply more than held their own

by sheer weight of superior design and workmanship, and who have steadily gone on paying dividends to stockholders out of cash earnings. That seems to us the better way. To have good patents is desirable, but to depend on them for monopoly and high prices is a mistake that leads to frightful disaster in the long run. The future in electric light and power belongs not to one but to many, each of whom will develop some specialty and will hold his market mainly by high quality and moderate prices. We may have said this a dozen times before, but it will bear repeating.

A PRIZE FOR INVENTORS.

The Metropolitan Traction Co., of this city, is in the mood to equip some of its lines with a better motive power than can be afforded by either the cable or the trolley, and it has offered a prize of $50,000 to any inventor who before March, 1894, will bring forward a system that shall "approximate the trolley as a standard of economy in operation but should be without the features objectionable to the public." The company has invited the State Railroad Commissioners to be the judges, but the evident inability of the Board to act in such a capacity will probably not stand in the way of some actual competition resulting from such a stimulative offer. The company wishes to put in as little additional cable as possible, the trolley it cannot obtain consent for, and horses are obsolete. The choice then is reduced to storage battery traction or the conduit, the latter, of course, including a possible resort to the alternating current. What the storage battery can do has been shown in the Waddell-Entz tests on Second avenue, and Mr. Albert Stetson is to bring the conduit question before the Institute on this Wednesday evening, when it will undergo discussion in all its aspects.

CABLES FOR THE PACIFIC.

The instructive article on cables for the Pacific, in this issue, written specially for us by Mr. W. J. Hancock, the government electrician of Western Australia, is of unusual interest at this moment when news is so anxiously awaited daily from the Sandwich Islands and is so painfully slow in arriving. The need for a Pacific cable was never more apparent than it has been lately throughout the Hawaiian imbroglio; but it must be obvious that our interests as well as those of all civilized peoples are rapidly growing in the Pacific and that it behooves us to be in closer touch with them. France has, in fact, already given fresh evidence of her wonderful revival of national pride and ambition by being prompt to connect New Caledonia with Queensland, thus building the first link in a greatly needed system; and it is understood that the same French Company, supported by the French Government, is ready and willing to go ahead with other sections, bringing its cable to our shores by way of the Fiji, Samoan, Fanning and Hawaiian Islands. Such a project not only deserves watching but seems worthy of American support and countenance. We may be sure that when England at last arouses to the situation, as she must, her cable will not be brought to San Francisco, but will head for Vancouver and leave us out.

A Judicious Change.

We congratulate our valued contemporary, *The Electrical World* on its change of size announced for January, 1894. Its new page will vary little in dimensions from that of The Electrical Engineer, and will bring *The Electrical World* into a form shown by the twelve years' experience of The Electrical Engineer to be preferred for convenience in reading as well as for preservation and binding. Our alert and entertaining contemporary is sure to be more appreciated than ever in its new form and dress. Its new departure should prove no less beneficial to itself than agreeable to its readers.

PERSONAL.

MR. J. H. RHOTEHAMEL.

It was a pleasure to receive a visit last week from Mr. J. H. Rhotehamel, President of the Columbia Incandescent Lamp Co., of St. Louis. That enterprising lamp company, having successfully resisted the imposition of a preliminary injunction in the suit brought by the General Electric Co. some months ago, reports a large and increasing trade, throughout the country in its "lawfully made" lamps. Mr. Rhotehamel is of opinion that the competition of the Columbia lamp has been a considerable factor in bringing about the recent reduction in lamp prices on the part of the General Electric Company.

MR. H. KODAMA.

H. Kodama, E.E., Engineer of the Tokyo Electric Light Company, is journeying around the world from Japan, examining and studying the development of electrical engineering. He has given several weeks to a stay in New York and vicinity, where he has found much of interest in his chosen field. Mr. Kodama is a graduate of the University of Tokyo, where he had the privilege of instruction from Professor Fujioka—well known in American electrical circles through his visits here in 1884 and 1887. Many electrical engineers in and about New York who have had the pleasure of meeting Mr. Kodama during the past few weeks, have been gratified to learn of the growth of electrical industry in Japan, and will hope to see him in America again at a not too distant time.

MR. C. W. KENNEY.

Mr. C. W. Kenney, of Laurel, Del., has been appointed to the position of manager of the goverment telegraph at the United States Senate, the lines of which connect the Capitol with the White House and all the other executive departments in Washington. Although he is only twenty-seven years of age, Mr. Kenney has had quite an interesting career, and has achieved distinction in other walks of life as well as in his profession as an expert telegrapher and electrician. He established the *Sussex Countian* of which paper he is the editor, and he went as delegate from the Peninsula Editorial Association to the convention of the National Editorial Association, at San Francisco, last year. He was appointed color sergeant on Gov. Briggs' staff in 1888, and colonel and quartermaster-general for Sussex county on Gov. Reynolds' staff in 1891. He was indorsed for the position to which he has now been appointed by Senator Gray, by the Governor of Delaware, and by the entire Democratic membership of the legislature of the Diamond State.

$50,000 PREMIUM FOR A GOOD SYSTEM OF TRACTION.

In a letter to the New York State Board of Railroad Commissioners, asking them to act as judges, the Metropolitan Traction Co. of New York offers $50,000 to any inventor who will give it a new and operative system of traction, as economical as the trolley, but superior to it in other ways. The commissioners are rather reluctant to assume any such responsibility, but will probably suggest means for carrying out the plan, which is as follows:

1.—We will set aside the sum of $50,000 to be awarded as a prize to any person who shall, before March, 1894, submit to your honorable board an actual working system of motive power for street railway cars demonstrated to be superior or equal to the overhead trolley.

2.—The qualities necessary to meet this requirement shall be left to your decision, but with the present state of the art, a system to win the award must necessarily approximate the trolley as a standard of economy in operation, but should be without the features objectionable to the public.

3.—We shall exact no rights in the invention in return for the $50,000, and shall have nothing whatever to do with the making of the award, further than to pay any expenses which your honorable board may deem it necessary or wise to incur, either in the employment of experts, the giving of hearings or the conduct

of experiments—this in order that no effort may be spared to achieve the desired result.

We desire, however, to suggest to your honorable board that any invention worth considering will ordinarily have inspired sufficient confidence in an inventor and his friends to warrant them in paying the expense of an experiment, providing facilities are furnished therefor. If we are asked to pay the expense of experimental forms of traction not sanctioned at present by any general use, we should desire to be consulted as a necessary precaution against visionary and unjustifiable expenditures by our company.

The advantages which would accrue to an inventor from the finding of your board in his favor and the adoption of his system by our company would be so great that we do not consider it necessary to stipulate terms for its use on our lines, especially in view of the fact that, in the event of exorbitant demands, it would remain in your power to take such action as in your judgment would be necessary for the protection of the public. As the proposal itself plainly indicates, our faith in the capacity, judgment, and fairness of your board is such that we feel warranted in practically placing the whole matter in your hands and leaving the decision of any questions that may arise to your discretion.

Permit us to say, in conclusion, that in submitting this proposition, we make no pretense of disinterestedness. Our motives, while not altogether selfish, are those of business. We do feel justified, however, in suggesting that, in this matter, at least, our interests are identical with those of the city.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION—EDISON LAMPS MUST NOT BE REPAIRED.

No. 3196.—Circuit Court of the U. S. District of Massachusetts. In Equity. Edison Electric Light Co., *et al. vs.* Davis Electrical Works, *et al.*—Opinion of the Court (Dec. 13th, 1893).

COLT, J.—If the Edison lamp were so constructed that a new burner could be placed in it like a new wick in an ordinary lamp, or if it were made of two parts designed to be taken apart for the purpose of replacing the old burner with a new one, as in the Sawyer-Man lamp, I should hold that a purchaser of the Edison lamp had a right to renew the carbon filament on the ground that this was an ordinary repair contemplated by the patentee when the lamp was sold, and that the defendant in so repairing such lamps did not infringe the Edison patent.

But the difficulty which meets me in this case is that the Edison lamp was not designed to be so repaired and is incapable of such renewal.

The Edison lamp is constructed as an organic whole, and you cannot break open the all glass chamber and insert a new filament without a substantial reconstruction of the lamp. The lamp is only intended for use during the life of the filament. In prior incandescent lamps, the life of the burner was brief, and it was necessary to so build the lamp that this part could be renewed. Edison, by making an almost perfect vacuum in the all-glass chamber, and thoroughly sealing all the parts, constructed a lamp in which the filament or burner lasts from six hundred to one thousand hours. To attain this result the lamp assumes a form of construction which renders it impossible to replace a new filament in the glass bulb without building essentially a new lamp.

When you take an Edison lamp with its filament destroyed and break open the all-glass chamber you have only left the broken pieces,—the remains,—of the original lamp. Its identity as a structure is gone. The only parts remaining which are not impaired or destroyed are the metallic head and the leading-in wires. When you build anew from such materials it is like breaking up an old machine and constructing a new one in which some of the old parts are used.

The defendants first break off the tip of the glass bulb of the lamp and ream out a hole almost one-half inch in diameter. The new filament, having its ends cemented into platinum sleeves, is then inserted into the glass chamber, the sleeves being pushed down over the two platinum leading-in wires, and compressed upon them. A tube of glass made into the shape of a funnel is heated and placed over the hole in the lamp chamber. This tube is fused into the open end of the bulb, which brings it into the condition of the ordinary lamp bulb just prior to exhaustion. The air is then exhausted and the bulb sealed.

It is evident that this operation covers many of the constructive features of the ordinary lamp.

When we consider what is done by defendants in connection with the second claim of the Edison patent, it is made clear, I think, that the defendants do more than merely repair.

The claim is for:

"The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted for the purposes set forth."

It will be seen that this claim consists of four elements; a carbon filament, a receiver made entirely of glass, conductors passing through the glass, and a receiver from which the air is exhausted.

It is apparent that defendants by substituting a new filament, making over the glass receiver, and exhausting the air from such receiver, produce a lamp in which all the elements but one (the leading-in wires) of the patented combination, are used either in a new or reconstructed form.

The lamp thus produced is substantially a new lamp and its voltage may be higher or lower than the old one. From the very nature of the Edison invention, I do not see how the glass bulb can be opened and a new filament inserted without making essentially a new lamp.

As to the new lamps which the defendants are charged with making, I find no sufficient proof that the defendants made, or threatened to make, them since the decision of the court sustaining the Edison patent. Their business seems to have been confined strictly to their so-called repairing. *Injunction granted.*

A MATHER SUIT AGAINST THE GENERAL ELECTRIC AS AN ILLEGAL CORPORATION.

JUDGE COLT in the United States Circuit Court, Boston, on Dec. 16, heard two cases brought against the General Electric Company. The first is that of the Mather Electric Company and the second that of F. D. Allen, district attorney, at the relation of the Mather Electric Company. Both suits seek to accomplish substantially the same result.

The Mather Company according to the papers filed in the case, is a Connecticut corporation engaged in the electric lighting business. It made a bid for furnishing the addition to the State House in Boston with electric lighting apparatus, offering to do the work for $60,000, which was the lowest bid made. This bid the commissioners stood ready to accept but for the alleged acts of the defendant, who, it is said, represented to the commissioners that the apparatus of the plaintiff infringed on patents controlled by the defendant, and if put in would be worthless. The claim of the plaintiff is that the General Electric Company is an illegal combination of interests operated for the purpose of restraining trade. It is also alleged that the representations of the defendant to the commissioners were untrue. The prayer of the plaintiff's bills is that the court restrain the defendant from interfering with the plaintiff in its transactions with the commissioners of the State House addition. The cases are heard on demurrers.

With regard to the item in last week's ENGINEER stating that the General Electric Co. had instituted a suit against the Mather Co. for infringement of an Edison patent for dynamo regulation, it will be of interest to add that this patent, entitled, Regulator for Dynamo Electric Machines, No. 264,668, Sept. 19, 1882, covers a method of compound winding.

BUCKEYE LAMP LITIGATION.

LAST Saturday the case of the Edison Electric Light Company against the Buckeye Electric Company again came up for hearing in the United States Circuit Court, at Cleveland, Ohio, before Judge Ricks, upon a motion made by the Buckeye Company to dissolve the injunction which had been granted by Judge Ricks against the Buckeye Company prior to that time. The Buckeye Company was represented by Messrs. Bristow and Cravath, of New York, and Judge Sanders, of Cleveland. The Edison Company was represented by Mr. F. P. Fish.

The claim of the Buckeye Company was to the effect that by reason of an endorsement made upon the patent by the Commissioner at the request of the Edison Company, in 1883, reciting the issue of the English patent, which expired November 10, 1893, and other foreign patents, the Edison Company was now estopped from denying or showing the fact that the English patent had not in fact been issued prior to the issue of the American patent, although the attorneys for the Buckeye company conceded the fact that the patent had not been so issued. Although it had been granted to date from November 10, 1879, it was not sealed and actually granted until some months later, and subsequent to the issue of the American patent. As a consequence, except for the endorsement made, the life of the American patent would not be limited by the expiration of the English patent. Courts have decided that such an endorsement is void and of no legal effect and upon the application of the Edison Company last spring, the endorsement made upon the patent in question, was cancelled.

The Buckeye company also claimed to have made large additions to their property which they used in their business prior to the granting of the injunction, and which additions were made upon the supposition, as they claimed, upon their part that the American patent would expire with the English patent. All of these claims by the Buckeye company were denied by the Edison company. The hearing consumed only a portion of the day.

ALLEGED INFRINGEMENT OF THE THREE-WIRE SYSTEM—WATERVLIET ARSENAL.

THE GENERAL ELECTRIC COMPANY have secured an injunction against the E. G. Bernard Company together with the Siemens-Halske Company and Major Isaac Arnold, commandant at Watervliet Arsenal, restraining the contractors from proceeding with the erection of the new electric plant, claiming it to be an infringement upon the Edison three-wire system. The case will be argued at Utica shortly, and promises to take as prominent a stand in electrical litigation, as the famous lamp cases. It is understood that it will be defended to the court of last resort.

EDISON LAMP LITIGATION—DE KHOTINSKY SUIT.

An action for infringement of the Edison lamp patent having been brought by the Edison Electric Light Co. against Capt. A. de Khotinsky, in the U. S. Circuit Court, at Boston, the court granted a restraining order.

NOW FOR AN ERA OF GOOD FEELING.

The recent suit brought by the Western Electric Co. against the General Electric Co. for damages due to the removal and complete disappearance in the night of the former company's signs from the electric light poles at the Fair, has been settled out of court, judgment having been formally entered against the General Electric Co. in the Circuit Court of Cook County for $800. Of this amount $300 goes to the Western Electric Co. as a reimbursement for the value of the signs and as covering legal expenses incurred, while $500, under the terms of the settlement, has been paid over to the Chicago Orphan Asylum. Lieut. Spencer, who had charge of the General Electric Co.'s exhibit at the Fair and under whose direction the signs were removed and destroyed has also made a full and ample personal apology to President E. M. Barton, of the Western Electric Co. Mr. Sunny, too, has expressed his regrets at the action of Lieut. Spencer. It seems that as the evidence for the damage suit was being collected, a criminal charge was made against Lieut. Spencer, which charge would have come to trial long before the civil suit, had not the above full and satisfactory settlement been made. Affidavits made by the men who removed the signs stated that Lieut. Spencer was on the spot and personally directed the disappearance of them. It also appears from one of the affidavits that the signs were heaved "overboard" into the lagoon by Lieut. Spencer's order; that this gentleman counted "One, two, three," and at the word "three," the order of execution, the signs went into the lagoon. The Western Electric Co. fished up enough of them to prove where they were, but they do not claim there was anything in their appearance to indicate that they were immersed at the word "three;" this came out, however, as above stated, in an affidavit. The incident has now passed, however, and Mr. Spencer very manfully apologized before the warrant was served upon him. The money has also been received by the Chicago Orphan Asylum as a very enthusiastic and grateful letter shows, addressed to Mr. Barton by President Norman Williams under date of Dec. 13.

OBITUARY.

OBITUARY.—G. H. BABCOCK.

George H. Babcock, the inventor of the Babcock & Wilcox boiler, died at his home in Plainfield, N. J., on Saturday, aged 62. He was the inventor of a chromatic printing press. During the war he invented a shrapnel shell. He amassed a large fortune. Since 1885 he had been president of the Plainfield Board of Education. He was the leading member of the Seventh Day Baptist Church there. A widow and son survive him. Mr. Babcock was an active and prominent member of the American Society of Mechanical Engineers.

LITERATURE.

Electricity at the Paris Exposition of 1889. By Carl Hering. The W. J. Johnston Co., Ltd., *New York*, 250 pages, 62 illus. Cloth, 8vo. Price $1.00.

This is in reality a portion of the reports of the U. S. Commissioners to Paris, supplemented by a report of the International Congress of Electricians held also at Paris in 1889. Mr. Hering states in his preface that the report was ready for press three years ago. It is a great pity that the volume did not issue before as it is a most interesting and valuable record. Not only does Mr. Hering enter into technical details with his wonted care and thoroughness, but he enhances the usefulness of his report by data of a historical and statistical nature. Each section is prefaced by a discussion of the subject in an informational way, resuming the state of the art, and then the various exhibits are taken up seriatim in a very systematic and judicious manner. Mr. Hering is strict in maintaining an impartial attitude with regard to the different types and manufactures, and after reading this report one regrets more than ever that his services were not availed of in electrical jury work at the World's Fair just past. The report is in fact a book of reference that must continue to be of service for many years to come, for even the earlier like work of Sprague and Heap remains valuable. We note that mistake is made in "Mc Intyre" joint (McIntire), "Crook's" tubes (Crookes'), and "Heissler" system (Heisler) and one or two other minutiæ; but as a whole the work is remarkably free from inaccuracy. The edition is limited and we would suggest that copies be secured promptly.

NYSTROM'S POCKET BOOK.

Mr. R. Grimshaw, M. E., of 171 W. 95th street, New York, is engaged in the revision and correction of the twentieth edition of Nystrom's Pocket Book of Mechanics and Engineering, and will be glad if any of the readers of The Electrical Engineer will apprise him of any errors in that publication. He is desirous of making it as accurate and complete as possible.

LETTERS TO THE EDITOR.

CHANGE IN THE AUSTRO-HUNGARIAN PATENT LAWS.

I am sorry to inform your readers who are inventors, that there is a bill now practically passed by the Legislatures of Austria and of Hungary putting an end to the present combined patent system of the two countries. After the 1st of January next, patents will have to be applied for in each country separately. Each country will have its separate taxes. A patent will have to be worked in each country separately, and in most respects the two countries will be independent of each other as regards patent practice, with this exception, that an application in one country gives provisional protection and priority in the other, provided an application be made there in due form within a period of ninety days. The expenses under the new system will be greatly increased. Any patent, however, filed *before* January 1 will come under the old arrangements.

Edward P. Thompson.

New York City, Dec. 12, 1893.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 82nd meeting of the Institute, will be held at Headquarters, 12 West 31st street, New York City, on Wednesday, Dec. 20th, at 8 o'clock, p. m. A Paper will be presented by Albert Stetson, Esq., on "The Practicability of Electric Conduit Railways." The paper will be illustrated by lantern slides.

A CHICAGO AGENCY FOR THE LA ROCHE APPARATUS.

Mr. William Hood who for the past five years has been prominently identified with electrical interests in the West has taken the agency for the La Roche apparatus, manufactured by the La Roche Electric Works of Philadelphia, and has associated with him in accepting this agency, Mr. Harry G. Osburn. Mr. Osburn is a gentleman too well known to the trade to need any introduction whatever. His business as a consulting electrical engineer and expert has been a most lucrative one and has given him an enviable reputation and acquaintance through the entire West and Northwest. We feel safe in predicting that the interests of the La Roche Company in the hands of such popular and competent men will soon gain a reputation in the West equal to that which the company enjoys throughout the East. The company through its Chicago office established but a few days has great reason to be proud of a handsome contract just closed, this contract being for a thirteen-hundred light alternator for the Macsota Electric Light Company of Big Rapids, Michigan. They have as well closed for several smaller machines this week. The office of the Chicago Agency is most centrally located at 239 LaSalle street in the stores which have been occupied by Mr. William Hood for the past three or four years.

AN "AUF WIEDERSEHEN" BANQUET.

Probably one of the most enjoyable parties that ever sat down to dinner at the Union League Club, Chicago, assembled there Tuesday evening the 12th inst. It was a delicate and graceful tribute on the part of Mr. F. S. Terry to the several gentlemen who have been so long associated with him in the Ansonia Electric Company. It is safe to say that there are very few, if indeed any, organizations wherein there exists such a feeling of unity and comradeship, and where there is so much of mutual help and encouragement shown to one another as there is between Mr. Terry and his corps of assistants. A suggestive and appropriate name is found in "The Sunrise Club" under which title they frequently meet to discuss business and pleasure.

The dinner was a thoroughly enjoyable affair. Col. Geo. Carter officiated as toastmaster and under his gentle prodding the various members were quickened into the liveliest repartee. Those present were F. S. Terry, Geo. Carter, Geo. W. Conover, Max Berg, C. M. Spaulding, M. M. Wood, W. R. Pinckard, D. E. Goe, F. M. Peirce, A. J. Venneman, A. S. Terry, R. E. Richardson and E. O. Weed.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOVEMBER 28, 1893.

Alarms and Signals:—

Train Signaling Apparatus, J. S. H. Pellat, Paris, France, 509,447. Filed Aug. 10, 1892.
Provides means for obtaining a graphic record of the movement of trains whose positions upon the lines are automatically signaled to a central station, and to transmit signals to the various engine men.
Signal Apparatus for Telephone Systems, J. J. O'Connell, Chicago, Ill., 509,484. Filed Apl. 17, 1893.
Police and Fire Alarm System, J. B. Gill, San Francisco, Cal., 509,524. Filed Dec 9, 1892.
Signal Apparatus, G. McIntosh, Stonington, Conn., 509,545. Filed Feb. 1, 1893.
A signal apparatus operated by fluid pressure actuated by an electrically controlled valve.
Fire Alarm Signal Box, J. M. Gardiner, Newton, Mass., 509,573. Filed Aug. 16, 1893.
Electromagnetic Alarm, P. Rabbidge, Sidney, New South Wales, 509,680. Filed Feb. 28, 1893.

Conductors, Conduits and Insulators:—

Coupling for Electric Conduits, A. Noll, New York, 509,608. Filed Aug. 5, 1892.
A coupling provided with a central enlarged portion fitted with an insulating tube and with interior recesses filled with cement.
Strain Insulator, C. H. Dey, Boston, Mass., 509,614. Filed June 5, 1893.
A strain insulator adapted to be adjusted like a turn buckle and having metallic bearing surfaces upon which the two members may turn.

Distribution:—

Electric Lighting System, J. D McGiffert, Elizabeth, N. J., 509,448. Filed March 24, 1893.
Employs a switchboard with several series of bearings and a contact lever fitted interchangeably to the bearings of the several series.
System of Electrical Distribution, T. A. Edison, Menlo Park, N. J., 509,517. Filed Dec. 12, 1888.
Employs two or more dynamos whose armatures are connected in multiple arc with a single circuit, an amperemeter in the armature circuit of each machine and means for regulating the E. M. F. of each machine independently of the other.
Laminated Converter Core, C. F. Scott, Pittsburgh, Pa., 509,770. Filed Nov. 25, 1892.

Dynamos and Motors:—

Combined Electric Motor and Induction Coil, J. S. Nowotny, Cincinnati, O., 509,445. Filed April 5, 1890.
Compounding Dynamo Electric Machines, W. H. Knight, Lynn, Mass, 509,-475. Filed Feb. 6, 1893.
Consists in varying the compounding effect of the coil while maintaining a constant resistance between its terminals.
Compounding Dynamo Electric Machines, H. F. Parshall, Lynn, Mass., 509,-486. Filed May 11, 1893.
Employs a resistance in series with the coil, a second resistance in shunt with a portion thereof and means for simultaneously and inversely varying the two resistances.
Regulator for Dynamo Electric Machines, E. Thomson, Swampscott, Mass., 509,499. Filed April 11, 1892.
Claim 5 follows:
A compound wound dynamo electric machine having its series winding divided into sections, and a shunt connection of variable resistance around a part only of such series winding.
Switching Apparatus for Electric Motors, P. Wright and Joseph W. Kinsey, Denver, Colo., 509,595. Filed Nov. 15, 1892.
Employs a double starting solenoid connected to a variable rheostat in combination with two switch controlling solenoids having mechanical and electrical connections whereby the current supply may be varied, broken or reversed.
Shaft Mount for Armatures, S. E. Hitt, Rockford, Ill., 509,620. Filed March 20, 1893.
Claim 1 follows:
The combination, with an armature, of the shaft, and a universal coupling between said armature and the shaft.
Dynamo Electric Machine, C. Hoffman, Berlin, Germany, 509,662. Filed Feb. 28, 1893.
Employs an armature having its periphery arranged to act as a commutator.
Electromagnetic Reciprocating Motor, R. Threlfall, Sidney, New South Wales, 509,705. Filed Feb. 24, 1892.
Electrical Controller, E. A. Sperry, Cleveland, O., 509,776. Filed Aug. 21, 1893.
A motor controller in which the circuit connections are automatically changed during a normal operation of the controller by the action of its principal moving element.

Galvanic and Thermo-Electric Batteries:—

Battery Box and Case, L. F. Jordan, Somerville, Mass., 509,381. Filed Oct. 8, 1892.

Lamps and Appurtenances:—

Electric Arc Lamp, E. P. Clark, New York, 509,842. Filed Jan. 28, 1893.
Employs a solenoid through which alternating currents flow whose shell is composed of non-conducting material and the core of iron wires enclosed in a sheathing of non-conducting material.

Measurement:—

Potential Indicator, G. A. Liutner, Minneapolis, Minn., 509,578. Filed Mch. 16, 1893.
The invention consists in the combination with an armature of a magnetic device the windings of which are arranged on bobbins connected in multiple arc with the dynamo circuit.
Electric Current Meter, W. T. M. Mottram, New York City, 509,750. Filed May 23, 1891
Employs a motor whose field is excited by the current to be measured and the armature by an independent local electrical supply of constant potential.

Miscellaneous:—

Electric Current Regulator, J. H. Clark, Boston, Mass., 509,363. Filed Dec. 30, 1891.
The regulator is provided with a movable stop, first moved into position to determine the maximum current, the movable member of the regulator being afterward automatically moved gradually to raise the current to the maximum.

Electric Elevator, C. R. Pratt, New York, 509,397. Filed Feb. 5, 1892.
Provides means by which the armature of the driving motor can be disconnected from the feed circuit and the field magnets remain in circuit while the car is descending so that the motor shall act as a brake.
Electric Elevator, F. B. Perkins, Boston, Mass., 509,821. Filed March 16, 1889.
A hydraulic elevator operated by a pump controlled by an electric motor.
Electric Plow, C. H. Roberts, Eau Claire, Wis., 509,556. Filed April 30, 1892.
Electrically Operated Jumper Drill, C. Hoffman, Berlin, Germany, 509,873. Filed Oct. 12, 1891.

Railways and Appliances:—

Electric Closed Conduit System for Railways, G. W. Von Siemens, Berlin, Germany, 509,403. Filed April 18, 1892.
Employs a series of sectional insulated conductors, polarized magnets carried upon the car, a normally open circuit between the main feeder of each sectional conductor, a series of electromagnets one for each sectional conductor, and contacts whereby these magnets are respectively polarized before the car magnets pass over them.
Conduit Electric Railway, A. Wörner, Buda-Pesth, Austria, 509,421. Filed Nov. 12, 1891.
Employs a compound rail for the passage of the contact maker connected to the car and a subway for the conductors so constructed as to support the members of the compound rail.
Electric Railway, T. A. Edison, Llewellyn Park, N. J., 509,518. Filed Aug. 14, 1891.
Employs a high tension circuit with reducing converters having their primary circuits connected thereto at intervals, a continuous circuit along the lines of the railway with which the secondary circuits of the converters are connected at intervals and working conductors connected to the supply circuit.
Clamp Ear for Trolley Wires, E. B. Gates, Decatur, Ill., 506,616. Filed Apl. 5, 1893.
Consists of a pair of plates each having jaws and intermediate spaces, the jaws in one plate fitting between the spaces of the other.
Conduit Electric Railway, E. H. Johnson, New York, 509,622. Filed May 16, 1893.
A conduit of V shaped cross section having a continuous lining of insulating material and a slot the full width of the conduit and a cleaning scoop carried by the car in advance of the current collecting device and substantially filling the conduit, the conductor being laid directly at the bottom.
Closed Conduit System for Electric Railways, E. Chabeault, Marseilles, France, 509,651. Filed Oct. 13. 1892.
Employs an electromagnet for raising movable contacts while the car is passing.

Switches and Cut-Outs:—

Electric Double Pole Fixture Cut-Out, H. E. Werline, Lancaster, Pa., 509,500. Filed Feb. 15, 1893.
The invention consists in forming the cut-out of segments separably connected through the pipe or steam opening therein.
Electric Pendant Cut-Out, H. E. Werline, Lancaster, Pa., 509,501. Filed Apl. 17, 1893.
Electric Switch, C. J. Klein, New York, 509,539. Filed Dec. 2, 1892.
Claim 2 follows:
In an electric switch, the combination with terminals of a buckling plate for closing the circuit, a push piece for buckling the plate and a push piece for returning the plate to its normal position.
Cut-Out, N. F. Adams, Boston, Mass., 509,718. Filed Feb. 18, 1893.
Employs a plurality of stationary members each provided with a fuse normally included in the circuit, combined with a movable member to co-operate with any of the stationary members and complete the circuit mechanically.
Lightning Arrester, A. Wurts, Pittsburgh, Pa., 509,783. Filed May 16, 1893.
Consists of a group of spark gaps each having a resistance in series sufficient when added to the resistance of the spark gap on discharge to cut down the dynamo current below the amperage necessary to maintain an arc.
Universal Non-Arcing Lightning Arrester, A. Wurts, Pittsburgh, Pa., 509,-784. Filed May 16, 1893.
Consists of two adjacent spark terminals separated by a space substantially enclosed and too narrow in proportion to its length to permit the formation of a dynamo arc upon the occurrence of a static discharge.

Telegraphs:—

Printing Telegraph, R. A. Fowden, Philadelphia, Pa., 509,430. Filed Jan. 31, 1893.

Telephones and Apparatus:—

Switchboard Circuit and Signaling Apparatus, F. W. Dunbar and E. S. C. May, Newark, N. J., 509,367. Filed March 7, 1892.
Relates to the arrangement of circuits on multiple telephone switchboards.
Trunk Line Signal, E S. C. May, Chicago, Ill., 509,477. Filed April 17, 1893.
Employs selective relays capable of being operated by the steady current of a battery but not by the alternating current from the generator.
Telephonic Apparatus, W. S. Harrison, Hong-Kong, China, 509,580. Filed Dec. 13, 1892.
Has for its primary object the application of a single fluid cell for the microphone circuit and secondarily the elimination of a switch.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 5, 1893.

Alarms and Signals:—

Thermometric Alarm, O. Weyrich, Elberfeld, Germany, 506,980. Filed May 16, 1893.
Electric Fire Alarm, M. C. Cantrell, Springfield, Mo., 510,115. Filed Mch. 2, 1893.
An automatic fire alarm operated upon the parting of a cord normally holding the circuit open.

Dynamos and Motors:—

Regulator for Dynamo Electric Machines, C. E. Scribner, Chicago, Ill., 509,953. Filed Dec. 10, 1888.
Provides means for automatically shifting the commutator brushes according to the load on the machine.
Dynamo Electric Machine, C. E. Scribner, Chicago, Ill., 509,954. Filed June 1, 1889.
The invention consists in providing a field for the short circuited coils energized by field magnets having their windings in a circuit of an approximately constant current.
Regulator for Dynamo Electric Machines, C. E. Scribner, Chicago, Ill., 509,-955. Filed June 1, 1889.
The invention consists in maintaining a practically constant field for the short circuited coils, of such a strength that the current built up will be equal to that in the circuit into which the short circuited coil is introduced at the moment the short circuit is removed.

Electrical Apparatus for Operating Dental Instruments, O. H. Pieper, San Jose, Cal., 510,048. Filed Nov. 25, 1892.
An electric motor and flexible shaft applied to dental drills, etc.
Electric Motor, A. H. Beard. Manchester, Alabama, 510,059. Filed June 10, 1892.
Comprises oppositely arranged fixed magnets with a lever vibrating between them, a second set of magnets secured to the lever and extending opposite the stationary magnets, helices loosely embracing one member of each set of magnets and circuit breakers adapted to permit the alternation of the current through the opposite pairs of magnets.
Electric Motor or Dynamo, H. K. Thiel, Alpena, Mich , 510,102. Filed Apl. 10, 1893.
Employs field magnet coils tapering toward the inner ends, and cylindrical windings thereon so that the number of ampere turns materially increases toward the inner ends of the cores.
Magneto Apparatus, A. F. Boardman, Somerville, Mass., 510,320. Filed Sept. 20, 1893.
Employs a field magnet consisting of a series of permanently magnetized rings and soft metal sectors located alternately between them.
Composition and Process of Producing Same for Commutator Brushes, R. Hirsch and H. Meminger, Milwaukee, Wis., 510,341. Filed Jan. 28, 1893.
Consists of pulverized graphite, powdered scouring substance and wax.
Reciprocating Electric Motor, A. R. Roe, Duluth, Minn., 510,367. Filed Nov. 21, 1892.
Claim 1 follows:
In a reciprocating electric motor, the combination of a series of field magnets arranged in the direction of the movement of the armature of alternately opposite polarity and a reciprocating armature provided with a series of coils arranged at intervals of its length shorter than the intervals between the field magnets.

Lamps and Appurtenances:—

Incandescent Electric Lamp, H. Green, Hartford, Conn., 510,018. Filed Oct. 17, 1892.
Employs a tapered stopper fitting into a tapered neck and a cushion or spring operating to constantly force and hold the stopper in position.
Electric Lighting System, G. B. Pennock, Chicago, Ill., 510,188. Filed Feb. 20, 1893.
Electric Arc Lighting System, D. Higham, Boston, Mass., 510,260. Filed July 6, 1893.
The method consists in producing in the series acting coils of the lamps current wave variations differing in phase from the current wave variations flowing through the lamps.
Arc Lamp Support and Connection, L. E. Thompson, Dunkirk, N. Y., 510,303. Filed May 10, 1893.
Bracket for Incandescent Lights, C. M. Berry, San Francisco, Cal., 510,317. Filed June 14, 1893.
Consists of a series of lazy tong sections with the lamp socket attached to the end section.

Measurement:—

Electrical Measuring Instrument, O. T. Louis, Philadelphia, Pa., 510,074. Filed March 28, 1893.
The action of the instrument depends upon the expansion of a conductor due to the heating effect of the current.
Combined Ammeter and Voltmeter, E. W. Jewell, Wheaton, Ill., 510,177. Filed July 1, 1893.
Claim 1 follows:
The combination with bell-shaped magnets and annular armature between their poles, of a counteracted conductor surrounding said armature, an index and scale.

Miscellaneous:—

Electrically Operated Railway Switch, H. L. Falco, Brooklyn, N. Y., 510,384. Filed Jan. 26, 1893.
Design for Galvanic Pile, N. P. Heskier, Copenhagen, Denmark, 22,954. Filed Sept. 19, 1892.
Process of Electrolytically Decomposing Fused Metallic Chlorides, F. N. Lyte, London, Eng., 510,276. Filed June 30, 1893.

Metallurgical:—

Manufacture of Metal Foil, E. Schröder, Berlin, Germany, 509,951. Filed Jan. 11, 1887.
The process consists of coating smooth bodies which are conductors of electricity with a thin film of an organic substance and depositing upon the film a precipitate of the metal of which the foil is to consist, and then drawing the foil from the smooth surface.
Method of Producing Metal Film and Metal Paper, C. Endruweit, Berlin, Germany, 510,013. Filed Feb. 21, 1893.

Railways and Appliances:—

Conduit Electric Railway, W. R. De Voe, Shreveport, La., 510,061. Filed June 12, 1893
Designed especially with reference to the perfect drainage of the conduit and the protection of the trolley wire from moisture.
Conduit Railway Trolley, P. C. Just, Chicago, Ill., 510,142. Filed Jan. 31, 1893.
Designed especially with a view to running at a high rate of speed and to prevent its leaving the wire in passing around curves.
Trolley and Trolley Switch, D. V. B. Smart, Troy, N. Y., 510,201. Filed Feb. 1, 1893.
Employs a trolley wheel with one flange higher than the other and a switch so arranged that the higher flange will run in a groove and guide the trolley as desired.
Support for Trolley Wires, J. E. Walker, Denver, Colo., 510,217. Filed May 8, 1893.
Has a longitudinal cylindrical hole for receiving the trolley wire which is held in place by a clamping piece, while the lower edge of the hanger is convex to conform to the trolley.

Switches and Cut-Outs:—

Circuit Breaking Apparatus, J. Burry, New York, 510,156. Filed July 14, 1893.

Telegraphs:—

Signaling Telegraph, M. J. Burns, Lowell, Mass., 509,878, Filed Nov. 25, 1892.
Telegraph Key, J. Steiner, Brooklyn, N. Y., 509,964. Filed May 8, 1893.
Telegraphy, P. B. Delany, South Orange, N. J., 510,002. Filed July 25, 1891.
Employs transmitting devices whereby alternating impulses of uniform duration may be transmitted over the line and provides for the maintenance of the continuity of the main line circuit whereby duplex working is rendered possible.
Telegraphy, P. B. Delany, South Orange, N. J., 510,003. Filed Jan. 23, 1892.
Similar in its object to No. 510,002.
Telegraphy, P. B. Delany, South Orange, N. J., 510,004. Filed Jan. 22, 1893.
Relates especially to an improved construction of the receiving apparatus.
Telegraphy, P. B. Delany, South Orange, N. J., 510,005. Filed April 14, 1893.
Designed especially for long submarine or underground cables.
Telegraphy, P. B. Delany, South Orange, N. J., 510,006. Filed July 22, 1893.
Has for its objects to provide a mechanical system to take the place of hand transmission over ocean cables and long land lines.
Telegraphy, P. B. Delany, South Orange, N. J., 510 007. Filed Jan. 22, 1893.
Has for its object to render the transmitted signals manifest at the receiving station by local devices controlled by the receiver in the main line.
Electric Telegraphy, C. Thom, Jr., Brooklyn, N. Y., 510,209. Filed Feb. 2, 1893.
Claim 4 follows:—
The combination in a duplex telegraph having a polarized relay, of an electromagnet and its armature acting to shunt the coils of the polarized relay in the artificial line.

Telephones and Apparatus:—

Spring-Jack Cleaner, C. G. Brady, Chicago, Ill., 509,867. Filed Sept. 30, 1891.
Testing Apparatus for Multiple Switchboards, F. R. McBerty, Downer's Grove, Ill., 509,932. Filed Feb. 7, 1893.
Employs a method which consists in charging a condenser in a circuit including the telephone by means of a direct current of an undulatory character.
Annunciator for Telphone Switchboards, C. E. Scribner, Chicago, Ill., 509,956. Filed May 2, 1893.
Provides annunciator circuits responsive to alternating and pulsating, but not to continuous currents.
Telephonic Transmission, J. S. Stone, Boston, Mass., 509,965. Filed May 22, 1893.
Employs a current supply circuit divided into two parallel branches containing respectively the transmitter and the primary helix of an induction coil, the branch including the primary being conductively continuous, and a direct circuit extending to a receiving telephone and including the secondary helix of the induction coil.
Automatic Telephone Exchange System, J. Serdinko, New Braunfels, Texas, 510,195. Filed Apl. 22, 1893.
Has for its object to enable the instruments to be connected by a signal wire, to dispense with an operator at the central station, to automatically register the messages sent by each subscriber and to automatically connect any two subscribers.

"ELECTRIC LIGHTING ON BUSINESS PRINCIPLES"—THE OTHER SIDE.

An editorial appeared in The Electrical Engineer of Oct. 4, entitled "Electric Lighting on Business Principles," calling attention to the apparent indifference of the managers of certain electric light plants, and remarking that, in many recent instances, economy, made necessary by the unparalled financial depression, had been regarded as synonymous with inefficiency. Reference was made to one company, whose name, however, was not mentioned, where the service was so bad that the business men and shopkeepers of the town were compelled to keep on hand a supply of jack lanterns and candles that they might be ready for the coming of the "regular breakdown" at the power house.

It was asked, Who is responsible for this miserable condition of affairs, who will remedy it, and when? In answer we are glad to quote part of a letter from the electrician of the Norwich, N. Y., Illuminating Company, who, inferring that his was the company referred to, has presented another version of the story as follows:

In December, 1888, we started this plant with one 60 h. p. boiler, one 60 h. p. Westinghouse engine and one 600-light Westinghouse alternating dynamo, with 400 lamps wired. Up to January, 1891, we had no trouble whatever, and had at that time increased our incandescent plant to about 1,200 lamps wired. Our old company, as designated below, had intended to build an entire new plant, but as the president had been doing something, say, bucking the Standard Oil Company, we were forced to the wall, with $70,000 liabilities. You, of course, understand, that a Sheriff's sale takes time, and the present owners have but just received a clear title, and now have commenced to improve. Your own judgment will be enough to tell you why they did not build.

Until last January we had no breakdown whatever to amount to anything. At that time, Jan. 24, 1893, our armature burned out. I rewound it and started again, and not till September 25 did we have any more trouble At the time of the last burnout we had a trifle over 50 amperes on a 30-ampere machine. I immediately rewound it and started it again on the fourth night. In the mean time enough consumers had changed to gas to bring our load to 35 amperes. The dynamo at this moment is running the lamps on 53 volts secondary, pretty near candle power.

Our plant at present is running, besides the incandescents, one 45 light commercial arc machine loaded full, and two city machines full, 10 amperes each. These are pronounced by almost everyone, as good as are to be found anywhere.

I have been in the business nine years and have made it a special study, and, in order to do so, I keep all the papers that I think will help me. Foremost among them is The Electrical Engineer. I do not pretend to be an expert, but considering the machinery I think that I have had very good luck; only two serious breakdowns in 5 years. This town has been remarkable in that more electricity is being used here in proportion to its size than in any town or city in the state, so far as I can ascertain, and people are constantly calling for more.

Our prices are reasonable and are as follows: 1 cent per ampere hour for incandescent lamps for which we are about to put in meters at the same rate. $100.00 per year for city lights which run all night and every night except the night of the full moon and four preceding nights, which is subject to variations as ordered by the vilage trustees according to weather. If the *Morning Sun*[1] paid for their lights as often or as well as they criticise people we should not object. But when they talk about consumers not paying for the last quarter to bring the company to terms, I think they are setting a pretty good example.

In conclusion let me add that we shall have before spring, an entirely new plant capable of supplying all the light needed. We have at present a new 1,300 light dynamo to run till the new plant is completed. Now that legal matters are straightened we are ready to do business; and the owners of this plant are practical men, who know how to run a plant, as they have others in operation which are giving perfect satisfaction, and who do not keep men who do not understand their business. That they are perfectly satisfied with my work, is attested by an offer of increased salary,

Berlin Iron Bridge Co.—The new roof for the new purifier house of the Northern Liberties Gas Co., is now being put in place by the builders—The Berlin Iron Bridge Co., of East Berlin, Conn.

1. The paper whose article furnished the text for the Engineer's editorial.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

F. P. LITTLE ELECTRIC CONSTRUCTION AND SUPPLY CO. AND THE KESTER ARC LAMP.

THE above named company, who for some time past have occupied the entire building, No. 135 Seneca st., Buffalo, have now filled their factory floors with such an amount of fine machinery

FIG. 1.—RETAIL DEPARTMENT, F. P. LITTLE ELECTRIC CONSTRUCTION AND SUPPLY CO.

and tools as to make it the largest concern of its kind in Western New York. The cellar or basement of the building is filled with all kinds of electrical supplies—wires, cables, insulators and porcelain goods, batteries, etc., while on the floor above are the store and retail department, shown in the engraving, Fig. 1. Further back on the same floor is Mr. F. P. Little's private office. We show on this page a view of the store floor.

On the floor above are the general offices of the assistant manager, treasurer, superintendent, bookkeeper, stenographer, etc. The rear of this floor is stored with glass globes, incandescent lamps and other supplies. The third floor is used to some extent for manufacturing, and is presided over by Mr. Kester, the man-

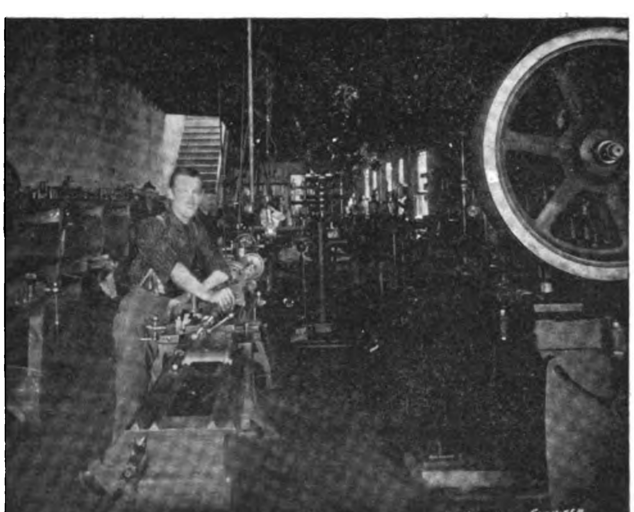


FIG. 2.—MANUFACTURING DEPARTMENT, F. P. LITTLE ELECTRIC CONSTRUCTION AND SUPPLY CO.

ufacturing superintendent who also has his laboratory or "den" on that floor. The fourth floor is devoted entirely to manufacturing, and the admirer of fine tools and machinery will find much to interest him in this busy place. In Fig. 2 we have reproduced a photograph which gives a fair idea of the front part of the floor.

Mr. Little may well be proud of the phenomenal growth of his business and establishment. Only two or three years ago he started the firm of F. P. Little & Co., at 141 Seneca st., and divided up his time between that concern and the Electric Light Co., at Black Rock, of which he was superintendent. He soon had to give up this position in order to take care of the growing business of his new venture. The next step was naturally expansion into a corporation and securing quarters and providing an establishment adequate to the needs of the business. One of the first plants installed by Mr. Little was at the Broezel House—a plant which THE ELECTRICAL ENGINEER illustrated and described at the time. This plant perhaps did much to make Mr. Little's work popular, for it is certainly a complete and very handsome installation. The manufacture of the "Kester" arc lamp was next taken up after the company had got into new quarters; these lamps are well known to the electrical public, having been on the market for some time.

The next article to be manufactured was the Kester alternating arc lamp. If there is a thing that will be handsomely and adequately rewarded financially, it is a perfect alternating arc lamp. The F. P. Little Electric Construction and Supply Co. feel confident they have such an article in the new "Kester" lamp, which

FIG. 3.—THE NEW KESTER ALTERNATING ARC LAMP.

is controlled, manufactured and sold by them. In designing this lamp, Mr. Kester very properly had in mind the efforts which have thus far been made towards producing an efficient and commercial alternating lamp, more especially the points in which, in his opinion, such lamps of the past and present may be considered weak and not altogether satisfactory. For instance he does not support his upper carbon holder with a flexible chain or cord which can be thrown off its pulley when the holder is thoughtlessly lifted; he uses instead a rigid rod. He has also found that those lamps in which the side rods form a guide for a cross-head to travel upon, may come to grief through the constantly increasing deposit of carbon and acid ash upon these rods, which increases the size of the rods (and also the friction upon them) until the lamp will stick. Then again he is not in favor of a long train of wheels in which the last wheel, controlled perhaps by a friction brake, rotates with such little force that the slightest dirt or sticking will stop it and with it the action of the lamp.

Mr. Kester has sought to avoid not only these points, but at the same time to do away with the intricacy of machinery and frequency of adjustment that are the features of some lamps he has tried. In some lamps a ratchet and clockwork is used not only for feeding but also in the dash pot, while in others a positive

feed is employed which necessitates the carbons actually touching before the proper arc is attained. Upon general principles Mr. Kester is not a believer in a friction feed in an alternating lamp, and he certainly has employed a novel and effective substitute for it in his lamp which we illustrate in the accompanying engraving. It will be observed from Fig. 3, that the Kester lamp is fitted with one train only of few wheels having comparatively large cogs; instead of a friction brake engaging the last wheel, the end of this train is a fan which rotates until it is lifted and is stopped to a dead certainty by a projecting pin. In actual work this fan makes only half a turn at a time, combining an absolutely dead stop with slightest feed to the carbon. The rod which furnishes a secure and rigid support for the upper carbon holder has a ratchet which engages a pinion on the "slow" end of the train of wheels. It will be observed that this rod may be easily raised or lowered in trimming without danger or damage of leaving anything wrong—as in the case of a flexible support which may be left off its pulley. The upper carbon holder has no connection whatever with either of the side rods of the lamp, so there is no necessity of keeping these rods oiled and absolutely clean; so far as the working of the lamp is concerned they might never be cleaned. The globe can be lowered instantly; the shell exposing the mechanism as easily as the globe, and without lowering the globe, and without removing the lamp from the line connections. The shell exposing the works can be removed without disconnecting the lamp from the live wires, or removing the globe.

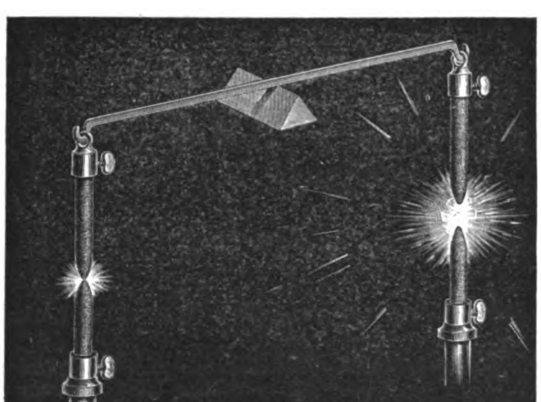
The Kester lamp consumes 9 amperes at 28 volts, and gives a perfectly steady and most satisfactory light. It requires no hood for outside use as it is perfectly waterproof; no rain or snow can get into the globe, and hence there is nothing to freeze up to annoy lamp-trimmers. There is no spring or weight in the lamp anywhere, and no friction-wheels to corrode and stick. Plenty of room has been allowed inside the lamp body for two lamps. Every part is made perfectly to standard and interchangeable.

The Kester lamp as a whole will thus be seen to embody all the principles of a successful practical lamp and the results already obtained with it in actual service bear out the claims of the inventor.

THE SEE-SAWING OF ARC LAMPS.

Where arc lamps are run two in series on incandescent circuits, much annoyance has been caused by their interfering with each other's regulation, the result being an alternate feeding and separating of the carbons which has been termed "see-sawing." For those who do not wish to go into the theory of this action, the simple analogy in the cut kindly loaned to us by Mr. George Cutter, of Chicago, may be interesting.

It will be remembered that all lamps of this class have the feeding mechanism controlled by two magnets, one being in the main circuit and in series with the arc itself, while the other is a shunt

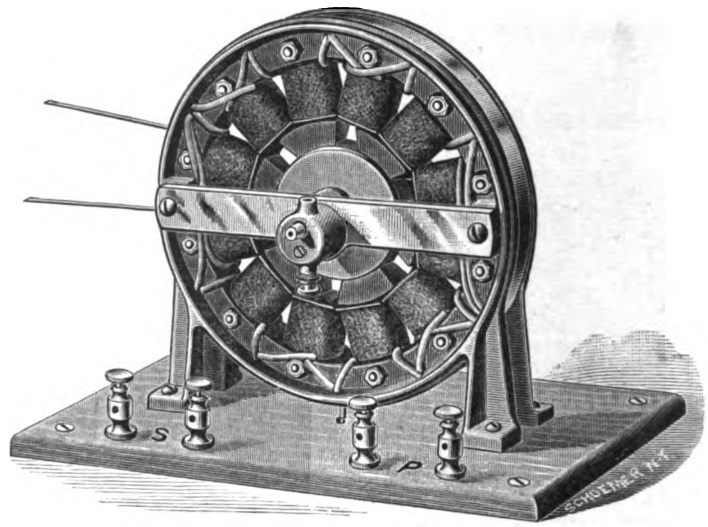


Prevention of See-Sawing of Arc Lamps.

around the arc. Then as the carbons burn away and the arc lengthens, the comparative resistance of the two paths for the current changes and allows the lamp to feed the carbon. In the case of series lamps, the main current is kept practically constant by the dynamo or its regulator, and the voltage at the lamp varies. But with a pair of lamps on a constant potential circuit the sum of the voltages remains unchanged, so that the increased consumption at one lamp will rob the voltage from the other, and vice versa. In other words the left hand arc in the cut will have very little counter-electromotive force so that most of the voltage will be left for the other one, and will draw the right-hand pair of carbons far apart. But this action exaggerates the difference in voltage still more, until the left-hand arc touches its carbons and then separates. In this way one pair of carbons will approach while the others are separating, the action being just as if they had a mechanical lever suspension as pictured. Mr. Cutter holds this matter of see-sawing to be one of the greatest problems met with in adapting arc lamps to incandescent circuits, but he thinks it is well met by the peculiar design of the Waterhouse lamps and it is said that users bear out his statement. At any rate the pictured analogy is interesting as showing a drawback which has at last been overcome.

THE KENNELLY THERAPEUTIC ALTERNATOR.

This little inductor alternator is intended for the production of sinusoidal alternating currents in electro-therapeutic treatment. It can be driven by a small motor from a battery of eight Edison-



Kennelly Therapeutic Alternator.

Lalande cells, or from a small motor on Edison incandescent circuits. The field frame is of laminated iron supported by castings, and has twelve poles. On each pole is a spool with two windings of wire. The inner has eight layers of fine wire, and the outer two layers of coarse.

All the fine wire coils are connected in one series which constitutes the secondary or delivery coil. All the coarse wire windings are connected in another series forming the primary or field winding of the machine. By this arrangement it is only necessary to drive the armature, which is a combination of laminated iron discs, to transform the battery or continuous primary current into alternating current waves in the secondary circuit; and by duly proportioning the grooves and projections on the armature surface these waves are made practically sinusoidal.

Twenty-four alternations of twelve complete periods are generated for every revolution of the armature, and since a speed of 4,800 revolutions per minute can be attained, the frequency can be carried to 960 periods per second. For steady running a more moderate speed and frequency will usually be desirable. A rheostat of wire for battery circuits, or of lamps when operating from incandescent mains, is included in the primary circuit of the alternator, by which the strength of the secondary currents can be controlled, independently of the frequency.

The sensations that are produced by the application of this apparatus differ radically from those which result from the employment of an ordinary faradic coil. They are much softer, more agreeable, equally developed at either pole, and generally exhibit the characteristic sensations attributed to sinusoidal currents.

The E. M. F. attainable in the secondary coils amounts to fifty volts, but on closing the secondary circuit under the conditions of ordinary application, the voltage at the secondary terminals falls to less than twenty volts, depending upon the amount of external resistance.

The battery output required to operate motor and alternator at full power is six amperes at four and a half volts pressure.

The alternator has self-oiling bearings, and is handsomely mounted on a polished wood base 11¼ x 7¼ inches, the height of the instrument being 8¼ inches. All the connections are under cover, and with no brushes to look after there is the minimum opportunity for derangement. The machine weighs ten pounds. It is made by the Edison Manufacturing Company, of 110 East 23rd street, New York city.

The Boston Offices of the Thomson Electric Welding Company have been removed to their works at Lynn, Mass.

ELECTRIC HAULAGE IN BROCK MINE, SCRANTON, PA.

THE mines of the Brock Coal Co. consists of five drift openings in a hillside about half a mile southeast of the town of Brockwayville, Jefferson county, Pa. But four of these drifts are in operation, and the seam of coal worked averages about 31 inches thick. In some places it is as much as 42 inches thick, and at others it is pinched out entirely. The present production of the four drifts ranges from 300 to 400 tons per day. The inclination of the seam is very slight, being merely enough to insure natural drainage for about five inches in 100 feet. The seam has a hard sandstone top and a soft fire-clay bottom.

The feeder is insulated copper wire of No. 00 B. & S. gauge, and the trolley wire is a bare copper wire of No. 0 B. & S. gauge. The feeder wire runs from the power house across the tracks to a point on the hillside above the tracks, and thence to No. 5 drift. The trolley wire runs along the upper side and close to the track.

It was desirable to have a substantial, economical and convenient system of haulage suitable for a track laid with light rails running in headings or gangways where mule haulage was impossible unless excessively large quantities of the fire-clay bottom were taken up. Electric haulage was deemed the best for the existing conditions, and the contract for the two locomotives and the entire plant was given the General Electric Co. The success of the electric haulage in meeting and overcoming the difficulties was such as to win for the system the highest indorsement from the officials of the Brock Coal Co. The construction of the plant is such as will commend it to any practical visitor to the mine.

Two locomotives are used, each of the same type and capacity. Fig. 1 shows one locomotive with a loaded trip. These locomotives, designed and built by the General Electric Company, are known as T. M. M., with a capacity of 1,500 lbs. draw-bar pull each. They are each of the following dimensions: 32 inches high, 48 inches wide and 9 feet 6 inches long. The wheels are 30 inches, and the axles 3¾ inches in diameter. The wheel base, which is rigid, is 42 inches. Each locomotive weighs about 9,500 lbs., and has two motors of the new iron-clad street railway type equipped with four-pole Gramme toothed-ring armatures. The armatures are series connected so as to use only two brushes each, and these are on the upper side of the commutator and in an easily accessible position. The armatures are connected with the axles by machine cut single reduction gears running in gear cases filled with oil. The frames are of cast steel and of such shape as to thoroughly protect the spools and armatures, which are thoroughly waterproofed. The trolley arms are supplied with universal joints so that they accommodate themselves to any position required by the location of the trolley wire.

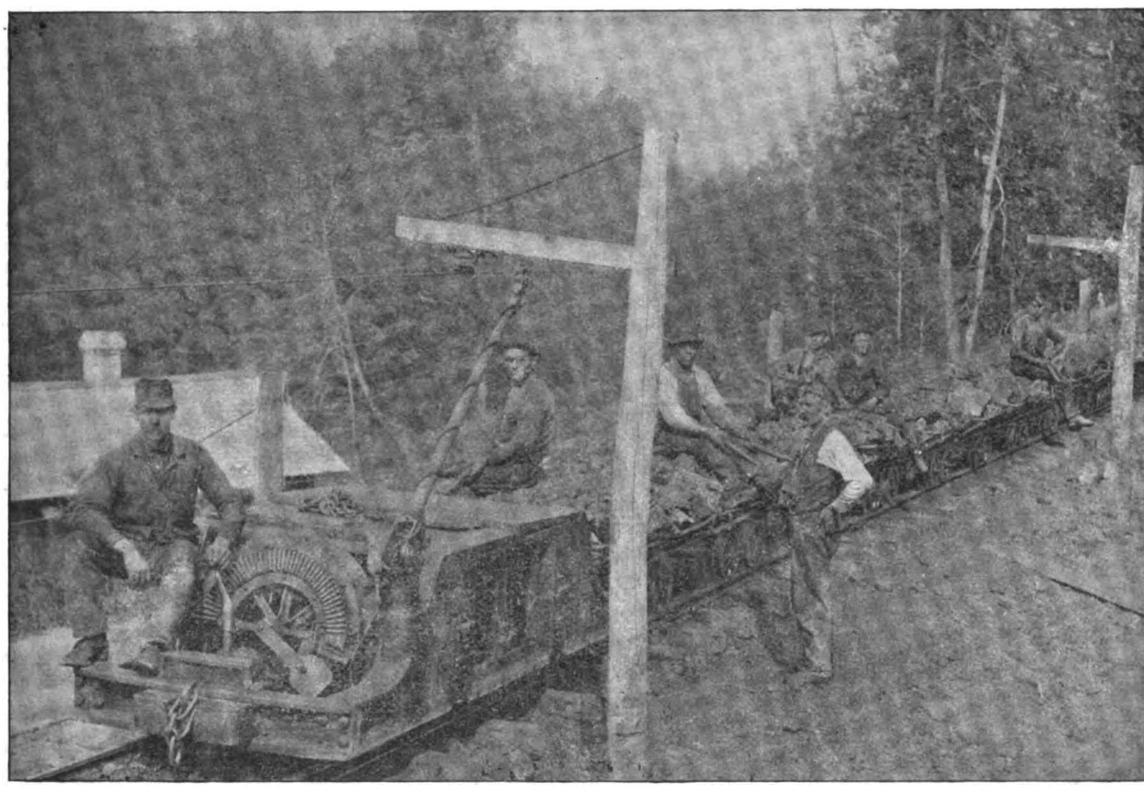
Power is furnished the locomotives from a Thomson-Houston D 40-220 volt generator run by an old style McEwen engine of about 80 h. p.

In speaking of the work of the locomotives Mr. Robert Dick, superintendent of the mine, says:

"They are doing good work and have entirely replaced the mules. Each locomotive leaves the chutes with its train of 26 empty cars and when the live workings are reached drops them at the various working places. It then returns, picking up loaded cars one by one, and at some points two at a time, and returns with them to the chutes every 40 minutes. The 26 loaded cars will average 20 tons of coal."

Dynamometer tests made on one of the locomotives showed a steady draw-bar pull of 2,700 lbs., or nearly 100 per cent. overload.

By referring to Fig. 1 it will be seen that the locomotive is very compact, and that it is low enough to run in much smaller headings than those at the Brock mine. It is conveniently arranged, so that the motorman can control it perfectly without leaving his seat. On the surface the trolley wire is suspended at a uniform height and distance from the rail. This is also the case in the mine, as far as possible, but it is not always practicable, and the special trolley arm is therefore required. The crew employed with each locomotive consists of a motorman at $2 per day and a boy spragger at $1.25 per day.



ELECTRIC HAULAGE IN BROCK MINE, SCRANTON, PA.

Mr. Burr E. Cartwright, president of the Brock Coal Co., in testifying to the success of this haulage plant, in a recent letter says:

"During the period of eight months from January to September, 1892, the total cost of producing the coal, as charged up on our books, eliminating certain regular fixed charges, was $36,-361.52; the number of tons produced in that period was 43,454, showing a cost of production per ton of $0.83678, this being before the introduction of electric haulage, except in a small experimental way.

"In the two months of March and April, 1893, after the electric traction system was fully installed and in operation, the figures appear as follows:

"Total cost of producing coal, less regular fixed charges, as stated in regard to the first period, $11,495.94. The number of tons produced was 15,415.29, showing a cost per ton of $0.74576.

"Comparing this cost per ton with the previous figures of the first period, shows a reduction in cost in this period of $0.09102 per ton.

"I regard the operation of the electrical apparatus as very satisfactory in every respect, and I intend to introduce it wherever opportunity occurs in our mining interests."

HARRISBURG IDEAL ENGINE.

MESSRS. F. E. BAILEY & Co., No. 18 to 24 S. 7th St., Phila., Pa., representing the Harrisburg Foundry and Machine Works, have made among others, the following sales of Ideal engines, complete steam plants, etc.: One 60 h. p. simple Ideal engine, for Cochran Hotel, Washington, D. C.; one 40 h. p. simple Ideal engine, for Musical Fund Hall, Phila., Pa.; one 35 h. p. simple Ideal engine, to Messrs. Frank P. Heid & Co., Phila., Pa.; one 25 h. p. simple Ideal engine, 40 h. p. Harrisburg steel boiler, and complete steam plant, for the Connecticut Plating Co., Phila., Pa.; two 60 h. p. simple Ideal engines, and complete steam plant, to Richard J. Lennon, Phila., Pa.; one 100 h. p, one 125 h. p., one 175 h. p. simple Ideal engines, three Harrisburg high pressure boilers, 375 h. p., and complete steam plant, for the Hanover Light, Heat and Power Co., Hanover, Pa.; one 125 h. p. simple Ideal engine, Harrisburg steel boiler, 150 h. p. and complete steam plant, for the Muncy Electric Light Co., Muncy, Pa.; two 175 h. p. simple Ideal engines, direct connected, with Waddell-Entz multipolar generators, for the State Hospital for the Insane at Norristown, Pa.; one Harrisburg high pressure boiler, 100 h. p., for the Bala & Merion Electric Co., Cynwyd, Pa.

Messrs. F. E. Bailey & Co. also have contracts for work at the Paxton & Stellton Co.'s Mills, Harrisburg, Pa., and for Harrisburg Preserving Co., Riverton, Pa.

RECENT NEW WORK OF THE BALL & WOOD CO.

IT is pleasant to know that some of our manufacturing establishments are busy in spite of the business depression, and although it is not customary for the Ball & Wood Company of New York to advertise their sales, recent inquiry shows such activity at the works of this company that for the encouragement of those who fear that the factories are all closing, we are permitted to publish the following recent orders on installations: At Binghamton, N. Y., two engines; at Faribault, Minn., two engines; at Hartford, Conn., one large compound engine; at Frankfort, Ky., one engine; at Meriden, Conn., three engines; at Naugatuck, Conn., two engines; at Buffalo, N. Y., one engine; at Canton, Md., three engines; at Sweveghem, Belgium, one engine; besides others in West Pullman, Ill., Elizabeth, N. J., Cloquet, Minn., Waterbury, Conn., Scranton, Pa., Bath, Me., and Millville, N. J. In addition to the above, the five engines comprising the exhibit of the Ball & Wood Company at the World's Fair, have also been disposed of, these engines being the first out of Chicago, as they were also the first installed.

THE "CENTRAL ELECTRIC" MATCH SAFE.

THE little pocket match safe given out by the Central Electric Co., Franklin street, Chicago, is one of the most popular novelties ever given away by a trade concern. It is a dainty folder of fine leather, with a pocket on one side and striker on the other. Every smoking man ought to provide himself with it, and the Central Electric Company will respond with prompt courtesy to any request for one, with which any of their friends will kindly favor them. We recommend early application. Requests should state the style of leather preferred, as the memento is made up in a number of designs.

A NEW CARPENTER CATALOGUE.

THE CARPENTER ENAMEL RHEOSTAT COMPANY, Bridgeport, Conn. (C. D. Shain, general selling agent, 136 Liberty street, N. Y.) has just issued a new and most interesting catalogue of its rheostat specialties. There are a number of new designs illustrated and described in it, and they are all so compact and handy that the uses for them will be endless. We recommend our readers to get a copy of this catalogue, December edition.

SOUTHERN ENGINEERING CO., INC.

THE above concern have their headquarters at 238 Fifth street, Louisville, Ky., where they deal in everything that pertains to steam, electrical and mechanical engineering. They invite correspondence, and guarantee that all orders and work will be carried out in the best possible manner. Their situation gives them excellent advantages in a large territory.

A BALL WORLD'S FAIR ENGINE SOLD.

THE 500 h. p. cross compound condensing engine exhibited by the Ball Engine Co., Erie, Pa., at the World's Fair, has been sold by them to the Maryland Lighting Co., Baltimore, Md. This engine received the highest award. The work of the engine at the Fair was driving the generators for the illumination of the special electrical fountains.

THE METROPOLITAN ELECTRIC COMPANY'S NEW INCANDESCENT LAMP.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, have added another very important article to their list of specialties—a new incandescent lamp. This is to be known as the "Metropolitan" and embodies the latest improvements in incandescent lamp manufacture. By the utilization of new and improved methods, the lamp offers, it is said, very high efficiency, and will maintain its full candle-power throughout its entire life, two elements of value in incandescent lamps that cannot be overestimated. The lamp has been patented, and the Metropolitan Company guarantee that it is non-infringing in every respect. It is now ready for the market, and orders can be filled promptly.

NEW YORK NOTES.

MR. A. L. TUCKER, of the Western Electric Co., of Chicago, has been East on a visit to New York, Boston, Philadelphia, etc. Mr. Tucker was in charge of the successful exhibit of the company at the World's Fair, and may be credited with much of the ingenuity shown in the clever little Scenic Theatre, which was visited by about half a million people. Mr. Tucker informs us that a Scenic Theatre is being fitted up for the San Francisco Mid-Winter Fair and that another is shortly to be started on State street, Chicago, with brilliant new spectacular effects. There is room for such theatres in every large city in the Union. Mr. Tucker also informs us that Mr. John Wanamaker has bought for his big store in Philadelphia the flashing column of light with its curious streamers. It runs up through two floors and is an object of great curiosity and admiration.

MESSRS. WARREN & BURHORN, of 136 Liberty street, inform us that they have taken the agency in this vicinity, and for export, of the Stearns Manufacturing Co. Their work includes all forms of boilers and wrought iron work, the Gill water tube boiler and the Woodbury engine, simple, horizontal and vertical tandem and cross compounds. Special attention is given to complete steam plants.

MR. W. F. BREITENBACH has started out from Buffalo on an extensive business trip through the South and West for the purpose of introducing the Kester arc lamps and other specialities manufactured by the F. P. Little Electrical Construction & Supply Co. of Buffalo, whom he will represent as general agent.

THE L. P. & D. TRANSMITTER COMPANY, of 136 Liberty street, New York, have just put into circulation a new catalogue of their power transmitter. It is elaborately gotten up and fully explains their system of transmitting power to dynamos, etc.

WESTERN NOTES.

THE CENTRAL ELECTRIC COMPANY, appreciating the increasing demand for the McCreary specialties, are carrying in their Chicago warehouse a complete stock of these goods, and state they are in a position to fill all orders upon receipt. They also report a number of large orders recently secured for the Cutter push button switches, both single and double pole, all of which have been filled from stock.

THE CENTRAL ELECTRIC COMPANY report having secured some large construction orders in the last ten days. They are having a thriving business in their Banner weatherproof wire, and have also secured the contract for the conduit and fittings and Okonite wire for the finest residence in the state of Ohio.

THE WESTINGHOUSE ELECTRIC AND MFG. CO. have established a district office at Portland, Oregon, to further their interests in Oregon, Washington and British Columbia. Mr. R. L. Warner, until recently connected with the engineering corps of the company, has been appointed district agent.

THE METROPOLITAN ELECTRIC COMPANY are gathering together a very important line of electric railway devices, prominent among which are the Standard Paint Co.'s P. & B. specialties; the "Anti-Thunder Bolt" oil paper, special oil glass insulators, "N. I. R." feed wire, etc.

NEW ENGLAND NOTES.

THE STATE STREET HORSE RAILWAY CO., at New Haven, Conn. have placed the contract for the roof on their new power house with The Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 84 feet wide and 250 feet long, the roof trusses being of iron, covered with slate.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVI. DECEMBER 27, 1893. No. 295.

THE DYING OUT OF ALTERNATE CURRENT WAVES.

BY

Chas. Steinmetz.

REFERRING to the inquiry in THE ELECTRICAL ENGINEER of Dec. 6, I may say that the secondary wave of an induction coil or converter is not necessarily flattened out, but may on the contrary be rounded. The phenomena taking place are the following :

In the ideal transformer, or transformer without self-induction, that is, a transformer in which all the magnetism produced by the primary coil passes through the secondary coil also, and no magnetism leaks through between primary and secondary coil,—the shape of the secondary E. M. F. wave and therefore of the secondary current wave, in so far as the current depends upon the E. M. F., is identical with the shape of the primary current wave so that the ideal transformer causes no change whatever in the wave shape, but simply transforms from quantity to pressure, and inversely.

But such an ideal transformer does not exist in practice, but merely haunts as a phantom transformer the text-books and mathematical treatises on transformers. In reality in the transformers of our alternating current systems not all of the magnetism produced by the primary coil passes through the secondary coil, but a part of the magnetism, from 1½ per cent. in the very best of transformers to about 15 per cent. or 20 per cent. in some inferior types of transformers, passes as magnetic leakage or stray magnetism between primary and secondary coil, giving rise to what is called the self-induction of the transformer. Such a transformer then acts like any other self-induction, as for instance a choking coil or reactive coil, and changes the shape of the current wave so as to make it smoother, *i. e.*, more resembling a sine wave.

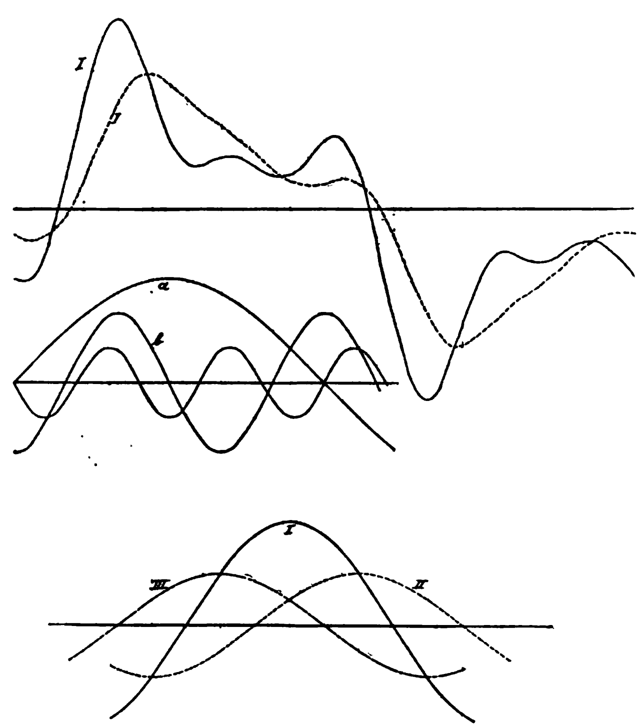
We see, therefore, that the tendency of the changes brought about by multiple transformation is not the flattening out but the approaching to sine shape and that the more transformations take place, the more the wave becomes a sine wave.

Obviously, if the primary wave is more pointed than the sine wave the change to sine wave means a flattening out. If, however, the primary wave is flatter than the sine wave, as it is, for instance, with an interrupted battery current in the Ruhmkorff coil, then the change to sine shape means a pointing of the wave.

Referring, however, to the use of self-induction devices in submarine telegraphy and in telegraph work in general, the object aimed at by the use of self-induction is not to produce a change in the wave shape but is to undo the change produced by the capacity of the cable or the line. The general alternate current wave, as the wave of telephone currents, etc., consists of a number of sine waves of different lengths superposed upon each other, as for instance the wave I shown in Fig. 1, which consists of three different waves of different lengths, shown in Fig. 2, as *a*, *b*, *c*.

The effect of self-induction is to retard the waves of current behind the waves of E. M. F.; hence if I in Fig. 3 is the sine wave of E. M. F. without self-induction, the wave of current will be the same as the wave of E. M. F. If, however, self-induction is present in the circuit, the current is retarded or kept back and appears later, just as the motion of a heavy mass takes place some time after the application of the moving force. The consequence hereof is that when the current reaches its maximum the E. M. F. which produced the current is decreased already and the current therefore is smaller than it would be without self-induction, and is represented in Fig. 3 by II.

While self-induction has a retarding influence, electrostatic capacity has an accelerating influence, and with capacity present the current reaches a maximum, as shown



FIGS. 1, 2 AND 3.

in curve III Fig. 3, before the E. M. F. is a maximum, and the current will therefore be less than it would be without capacity. Therefore self-induction and capacity have the opposite action, the former retarding, the latter accelerating the current. Both, however, have the same effect of weakening the current by making its maximum coincide with a lower E. M. F.

Obviously by connecting a proper amount of capacity into a circuit with self-induction we can annihilate the retardation due to the self-induction by the acceleration due to capacity, and thereby bring the current back to coincidence with the E. M. F., *i. e.*, to the large value I, Fig. 3 ; and inversely, if the current is weakened by the existence of capacity in the circuit we can destroy the acceleration produced by the capacity by a corresponding retardation produced by the insertion of self-induction, as, for instance, by transformation with a transformer containing a con-

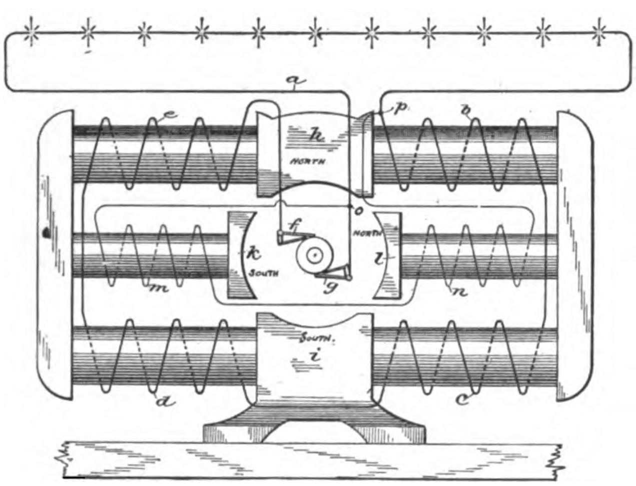
siderable amount of self-induction, and thereby get rid of the weakening effect of capacity, as Prof. S. P. Thompson proposes for telephone cables.

Since the action of capacity or self-induction is more intense upon shorter waves, the shorter waves are weakened more, or almost destroyed, and thereby the articulation of speech in a telephone, which is due to the shorter waves, impeded. Therefore it is important to devise means to get rid of this selective effect of the line capacity which tends to destroy the important waves of articulation.

So for instance, in Figs. 1 and 2, the shorter waves will in general be almost destroyed by self-induction or by capacity, and the current produced by the E. M. F. (I) will be represented by the curve II in Fig. 1 if self-induction is present.

THE SCRIBNER CONSTANT CURRENT ARC DYNAMO.

Mr. Charles E. Scribner, of the Western Electric Co. has recently devised an interesting method of avoiding sparking at the brushes of dynamos due to sudden changes of load and described in a patent just issued. In this system the current built up in each coil while it is short circuited is of the same direction and strength as that in the circuit of the current producing coils into which it is



The Scribner Constant Current Arc Dynamo.

introduced when the short circuit is removed; that is to say, while each coil is short circuited its current goes to zero and then is built up to a certain extent, and by controlling this building up of the current in such manner as to make the current built up equal to that in the circuit of the coils into which it is introduced objectionable sparking is avoided.

By reference to the accompanying diagram it will be seen that the main circuit *a* including the lamps may be traced through the coils *b c d e* of the field magnets of the short circuited coils and thence through the pairs of brushes *f g*. The poles *h i* are thus magnetized by these coils. In addition to these field magnets of the short circuited coils there is provided the pair of magnets *k l* with the coils *m n*; these coils are included in a shunt circuit between the points *o p*, which are connected with different sides of an arc light circuit. The magnets *k l* which have their coils included in the shunt between the points *o p* on different sides of the lamps are so placed with reference to the brushes and the revolving armature as to produce a field, whose lines of force are cut by the current producing coils. It is evident that as the number of lamps in the circuit is increased more current will be sent through the coils *m n*; in other words, the increase of work to be done increases the field of the coils which produce the current to do the work, and vice versa.

The poles *h i* are in position to produce a field which is cut by the short circuited coils and the windings *b c d e* are such that the circuit built up in the short circuited coils is equal to the current in the circuit of the current producing coils into which the short circuited coils are introduced.

According to Mr. Scribner between fifty and sixty thousand ampere turns of No. 16 wire upon poles which determine the electromotive force of a dynamo of one thousand to twelve hundred volts maximum capacity will give the desired regulation. The size of the field should be so proportioned that this number of turns will have a resistance of from five to six hundred ohms. The main fields may be varied to give the proper current in the short circuited coil upon first building the dynamo, the number of ampere turns necessary depending of course upon the character of the iron used and the shape of the pole pieces of the main field cores.

If the dynamo at one thousand volts with the brushes clean gives a current higher than is desired, a reduction in the number of ampere turns upon the magnets whose poles *h i* are placed over the short circuited coils can be made to bring the current to the desired strength.

THE LIMITATIONS TO LONG DISTANCE TELEPHONY.—II.

BY

H. W. Dunbar

The rate of propagation varies directly as the wave length and is equal to the product of the rate of alternation and wave length. Thus, pitch 160 travels (160 × 1060) or 170,000 miles per second and pitch 320 travels (320 × 585) or 186,000 miles per second in the special case cited. Thus the octave reaches Chicago nearly $\frac{1}{10000}$ second ahead of the fundamental. When this difference in time approaches a magnitude of $\frac{1}{10}$ second it may become necessary to introduce retardation into the circuit to improve the articulation. But the ordinary telephone user would naturally talk slower and thus avoid the difficulty, when he realized that he was conducting a conversation at a distance of 1,000,000 miles.

Let us now examine the stated limitation due to the distortion of the wave owing to the unequal decrements of the component parts. An examination of equation (4) shows us that the value of the current at the extreme end of the line for any given rate of vibration is determined by three separate laws. First, the logarithmic decrement between limits represented by $\frac{e^{\frac{pl}{2}}}{e^{pl}-1}$ on account of which the value of the current falls off with some power of the distance from the origin, this power being determined by the values of L, C and R. As L increases, this power decreases and with it the decrement of current.

Second, the absolute value of the current for any given E. M. F. varies directly as the square root of the number of vibrations, thus tending to increase the value of the current as the number of alternations increases.

Third, the current varies inversely with $\sqrt{R^2+L^2\,\omega^2}$ or increases with a decrease in L.

Let I represent the maximum value of the current which occurs when the time is such as to render $\left(\omega t + \tan^{-1}\frac{p}{a}\right) = 90°$, or its sine $= 1$. Then equating $\frac{dI}{d\omega}$ to zero we may determine the value of ω which will render I a maximum at the distant end of the circuit;

$$I = -\frac{2\,E\,\sqrt{c\omega}}{\sqrt[4]{R^2 + L^2\,\omega^2}}\left(\frac{e^{\frac{pl}{2}}}{e^{pl}-1}\right) \text{ is a maximum when}$$

$$\frac{\sqrt{c\omega}}{\sqrt[4]{R^2 + L^2\,\omega^2}}\left(\frac{e^{\frac{pl}{2}}}{e^{pl}-1}\right) \text{ is a maximum.}$$

Remembering that the factor $\left(\frac{e^{\frac{pl}{2}}}{e^{pl}-1}\right)$ changes to $\frac{e^{\frac{pl}{2}}}{e^{pl}+1}$ as l changes from a multiple of x_λ to an odd multiple of $\frac{1}{2}\,x_\lambda$, we may assume its mean value $e^{-\frac{pl}{2}}$ with no error. But it must be remembered that when l is less than $\frac{1}{2}\,x_\lambda$ the general equation (1) must be discussed, as its simplification is no longer true. It will be shown later that all important telephonic rates will render $l > \frac{1}{2}\,x_\lambda$ on the lines under discussion. Therefore, when $\frac{\sqrt{c\,\omega}\,e^{-\frac{pl}{2}}}{\sqrt[4]{R^2 + L^2\,\omega^2}}$ is a maximum,

$\frac{1}{2}\,log\;c\omega - \frac{1}{4}\,log\;(R^2 + L^2\,\omega^2) - \frac{pl}{2}$ will be a maximum. Differentiating and equating to zero, we have

$$\frac{1}{2\,\omega} - \frac{L^2\,\omega}{2\,I_m^2} - \frac{l}{2}\left\{\frac{R_o^{1/2}\,C}{4\sqrt{\frac{c\omega}{2}}} - \frac{L\,p}{2\,I_m}\right\} = 0.$$

Solving, we have $\omega = \frac{R^2}{LR_o}\sqrt{\frac{2}{lp} - 1}$ (8).

where $R_o = \sqrt{R^2 + L^2\,\omega^2} - L\,\omega$.

This shows us that ω is imaginary unless $\frac{2}{lp}$ is greater than 1, or $\frac{lp}{2}$ (the exponent of e) is less than 1.

Hence $\frac{l}{2}\sqrt{\frac{c\omega}{2}}\sqrt{(R^2+L^2\,\omega^2)^{1/2} - L\omega} < 1$;

$$\text{or } \omega^2 < \frac{64}{l^2\,C\,(R^2\,l^2\,C - 16\,L)}. \qquad (8a).$$

Substituting the constants of the Chicago line we have

$$\omega^2 < \frac{64}{4\times10^6\times\frac{.017}{10^6}\left(4.84\times4\times10^6\times\frac{.017}{10^6} - 16\times.0016\right)}$$

or $\omega < 55$.

Hence if there be a maximum value, ω must be less than 55. We may then first see if a value of $\omega = 55$ will make $l > \frac{1}{2}\,x_\lambda$.

Substituting in equation (7),

$$x_\lambda = \frac{2\,\pi}{\sqrt{\frac{c\omega}{2}}\;\sqrt{(R^2+L^2\omega^2)^{1/2}+L\omega}} = \frac{6.28}{\sqrt{\frac{.017}{10^6}\times\frac{55}{2}}\sqrt{(4.84+.007)^{1/2}+.09}} = 6{,}300 \text{ miles.}$$

Therefore, $\frac{x_\lambda}{2} = 3{,}150$, which is *greater* than l. This shows us then that there can be no real value of ω to render I a maximum in the cases under discussion, but that the current at the distant end will decrease with an increase in the rate of alternation.

But in general, to render the condition, $\frac{pl}{2} =$ or < 1, applicable to telephony the value of L must be increased, for equations (8a) and (7) show us that if L be *decreased*, approaching zero, the value of ω necessary to produce a possible maximum decreases slowly, approaching 54 as a limit, and the wave-length by the same change approaches infinity; thus the condition that the wave-length shall not exceed twice the circuit length cannot be fulfilled by a *decrease* in L.

But an increase in L *increases* the value of ω necessary to possibly secure a maximum current and at the same time decreases the wave-length. Thus, by increasing L, at some point a value of ω may be secured which will render the current a maximum. When

$$16\,L = R^2\,l^2\,C \qquad (8b).$$

this value of ω may be anything less than infinity.

Any further increase in L would render ω again imaginary. But when (8b) is true and ω has a value exceeding that capable of rendering x_λ equal to, or less than, $2\,l$, $\frac{pl}{2}$ will be equal to unity and practically independent of ω as may be shown by direct substitution. Hence this value of $\frac{pl}{2}$ just fulfills the condition expressed in (8) that $\frac{pl}{2}$ must be unity, or less than unity.

Also, we see from (8a) and (8b) that no values can be assigned to the constants $R\;L\;C$ and l which will render $\frac{lp}{2}$ *less* than unity and still permit a finite value of ω to secure a maximum current.

Thus the only value that $\frac{pl}{2}$ can assume and permit a finite value of ω to secure a maximum current, is *unity*. But we have shown that at this point the value of ω may be anything less than infinity and greater than that value which is necessary to produce at least one-half a wave-length in the complete circuit.

In other words $\frac{pl}{2}$ is practically independent of ω when equal to unity. This explains the meaning of a finite form to the expression for ω in (8) only when $\frac{pl}{2}$ is equal to unity. It will be shown later on that when $\frac{pl}{2}$ = unity, the inductance (L) of the line also has the proper value to render the current a maximum at the distant end for all rates of alternations.

At this point an increase in the rate of alternation, after that rate is passed which will give at least one-half a wave length in the complete circuit, will no longer be attended by an increased decrement in the current.

But it is evident that, as the Chicago line exists, the decrement does increase with an increasing rate and a calculation only will tell the magnitude of this distortion.

Substituting again the constants for a rate of 160 alternations per second, which, as stated, fairly represents the average fundamental of the male voice and is consequently the lowest rate of importance, we have:

$$I = -\frac{2\,E\sqrt{\frac{.017}{10^6}\times1{,}000}}{\sqrt[4]{\{\,4.84+(.0016\times1000)^2\,\}}}\times\frac{e^{1000\sqrt{\frac{.017}{106}\times\frac{1000}{2}}\;\sqrt{\{4.84+(.0016\times1000)^2\}^{1/2}-1.6}}}{e^{2000\sqrt{\frac{.017}{106}\times\frac{1000}{2}}\;\sqrt{\{4.84+(.0016\times1000)^2\}^{1/2}-1.6}}}$$

$= -\,2\,E \times .000122$ ampere.

For a period of 320 per second or the first prominent overtone we have, $I = -\,2\,E \times 0.000093$ ampere. For a period of 5,120, or five octaves above the fundamental, a tone above the range of the piano we have $I = -\,2\,E \times 0.000085$ ampere.

Thus the most prominent overtone of the male voice suffers but 25 per cent. greater loss upon the line than the

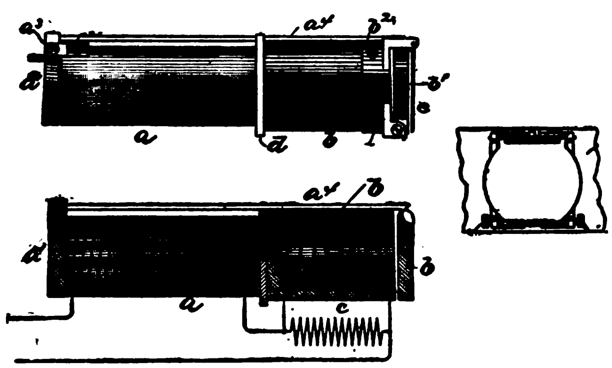
fundamental and above this rate the difference becomes negligible; there being but a 30 per cent. greater loss to the fifth octave than to the fundamental itself.

This difference in the rate of decay may be completely disregarded when we consider the modifications produced by other causes, including the transmitting and receiving instruments. As a matter of fact, owing to the construction of the transmitter, tones of a high rate of alternation are transmitted with more prominence than those of lower frequencies, and it will always be possible to correct for any such slight distortions in the wave by a correct design of the transmitter and receiver.

The important consideration, however, is that when the line is constructed to give a maximum current at the distant end there will be no difference whatever in the rates of decay, and the second limitation to telephony disappears theoretically as completely as it has never existed practically.

THE SCRIBNER TELEPHONE ANNUNCIATOR.

One of the most serious inconveniences attendant upon the operation of grounded circuit telephone exchanges in cities where the streets are traversed by electric railways is due to the fact that the continuous current from the latter will frequently find circuit from earth at the sub-station, through the telephone line circuit and annunciators, to earth at the central office, and frequently operate a whole bank of annunciators at once, to the serious detriment of



Figs. 1. 2 and 3.—The Scribner Telephone Annunciator.

business. To obviate this difficulty Mr. Charles E. Scribner, of the Western Electric Company, has devised an annunciator which will act upon the passage of alternating or pulsating currents but remain unaffected by continuous currents.

The principle is shown in the accompanying illustrations, where Figs. 1 and 2 are exterior views of the apparatus and Fig. 3 shows the circuit diagram. The magnet *a* may be wound to have a resistance of say five hundred ohms and a considerable self-induction so that it can be bridged between the different sides of the telephone circuit in the usual manner; the magnet *b*, however, is constructed with very heavy walls and with a thick magnetic circuit so that its coil, although of comparatively low resistance, will have great self-induction. The resistance *c* is arranged to be non-inductive and may be equal to, or somewhat greater than, that of magnet *b*.

The circuit will be seen to be extend through the coil *a* to one terminal of the magnet *b*, where it divides, two parallel paths being provided, one through the magnet *b*, and the other through the non-inductive resistance *c*. When a continuous current traverses this circuit it flows through the magnet *a* to the magnet *b* and there divides between the coil of magnet *b* and the non-inductive resistance *c* in inverse proportion to their actual resistances. Both magnets *a* and *b* are thus energized and both armatures *a′* and *b′* are attracted to their respective magnets; but the indicator or shield *d* remains unaffected, since, although the shutter *b′* is disengaged, it is still retained inoperative by its magnet *b*. When an alternating or pulsating current of comparatively high period traverses the magnet *a* to the terminal of magnet *b* by far the greater portion of the current passes thence in shunt around the magnet *b*, through the non-inductive resistance *c*, since the magnet possesses such great impedance. This magnet thus remains inert, or only feebly magnetized, and does not hold the armature *b′* which, when released through the movement of armature *a′* toward its magnet *a*, falls and gives the indication.

MAGNETIC SUSCEPTIBILITY OF OXYGEN.

Wiedemann's Annalen der Physik und Chemie for November contains an interesting paper by R. Hennig. on the magnetic susceptibility of oxygen. The method employed, namely, the measurement of the displacement in a magnetic field of a short column of liquid in a slightly inclined capillary tube, due to the difference in the susceptibility of the two gases (oxgen and air) at the two ends of the liquid column, would hardly seem at first sight capable of giving very accurate values. The author, however, has obtained very fairly consistent results, and finds the value 0.0963×10^{-6} for the difference between the susceptibility of oxygen and air at a temperature of about 26° C., and at pressures varying from 75 cm. of mercury to 328 cm. In order to measure the strength of the magnetic field a small coil was suspended by a bifilar suspension close to the capillary tube, and from the deflection, when a known current was passed through this coil, the strength of the field was calculated. The results obtained by this method were also compared with those found by the rotation of polarized light in a piece of heavy glass, and by means of a small induction coil which could be rapidly moved out of the field.

PRESERVATION OF TIMBER BY ELECTROLYSIS.

The impregnation of timber can, it is said, be very quickly and expeditiously carried out by the aid of electricity. The apparatus comprises, says the *Moniteur Industriel*, two boilers for the preservative liquid to be injected, a circulating pump and its motor, a steam boiler and a dynamo. The saline liquid is heated in the usual manner by means of a current of steam. At the same time an electric current is passed through the impregnating boiler. The combined action of the electric current and the heat causes the timber to be thoroughly impregnated in one hour, while the usual process with heat, but without the electric current, takes from 10 to 40 hours.

THE MOISSAN ELECTRIC FURNACE.

In the *Comptes Rendus* for November 20th, M. Henri Moissan describes the latest type of electric furnace employed by him. His first furnace consisted of two hollow blocks of quicklime, which were superimposed one on the other. In the type of furnace now described by him he has substituted blocks of Coursom stone for the quicklime briquettes, and has lined the interior with four layers of magnesia and carbon, arranged alternately, the first layer of magnesia being next to the arc. By the employment of magnesia higher temperatures can be attained than has hitherto been the case.

STREET ELECTRICS FOR MAIL CARS.

Postmaster-General Bissell, in his first annual report on the working of his department, favors the utilization of local electric car lines for mail transportation. He includes both rapid transit city and suburban lines in this recommendation. Mail is already thus handled on many suburban lines to the great advantage of the residents.

IMPORTANT TRANSMISSION OF POWER AT SALT LAKE CITY, UTAH.

The Big Cottonwood Power Company have filed articles of ncorporation and will use the waters of the Big Cottonwood and other streams, for the transmission of electricity for lighting, heating, cooking, and for power. The capital stock is fixed at $1,000,000, divided into 10 shares of the par value of $100 each.

The assets of the company consist of "The Stairs" waterpower in Big Cottonwood Cañon, 14 miles from the centre of distribution in Salt Lake City, which property will produce 2,500 h. p. during the lowest flow, and above 3,000 h. p. during eight months of the year. The water will be utilized under 380 feet head, and will be conducted a distance of 1,800 feet through a steel pipe 54 inches in diameter. It will be taken from a reservoir or natural basin known as "the Lodge," and first conducted through 480 feet of tunnel which is now nearly completed.

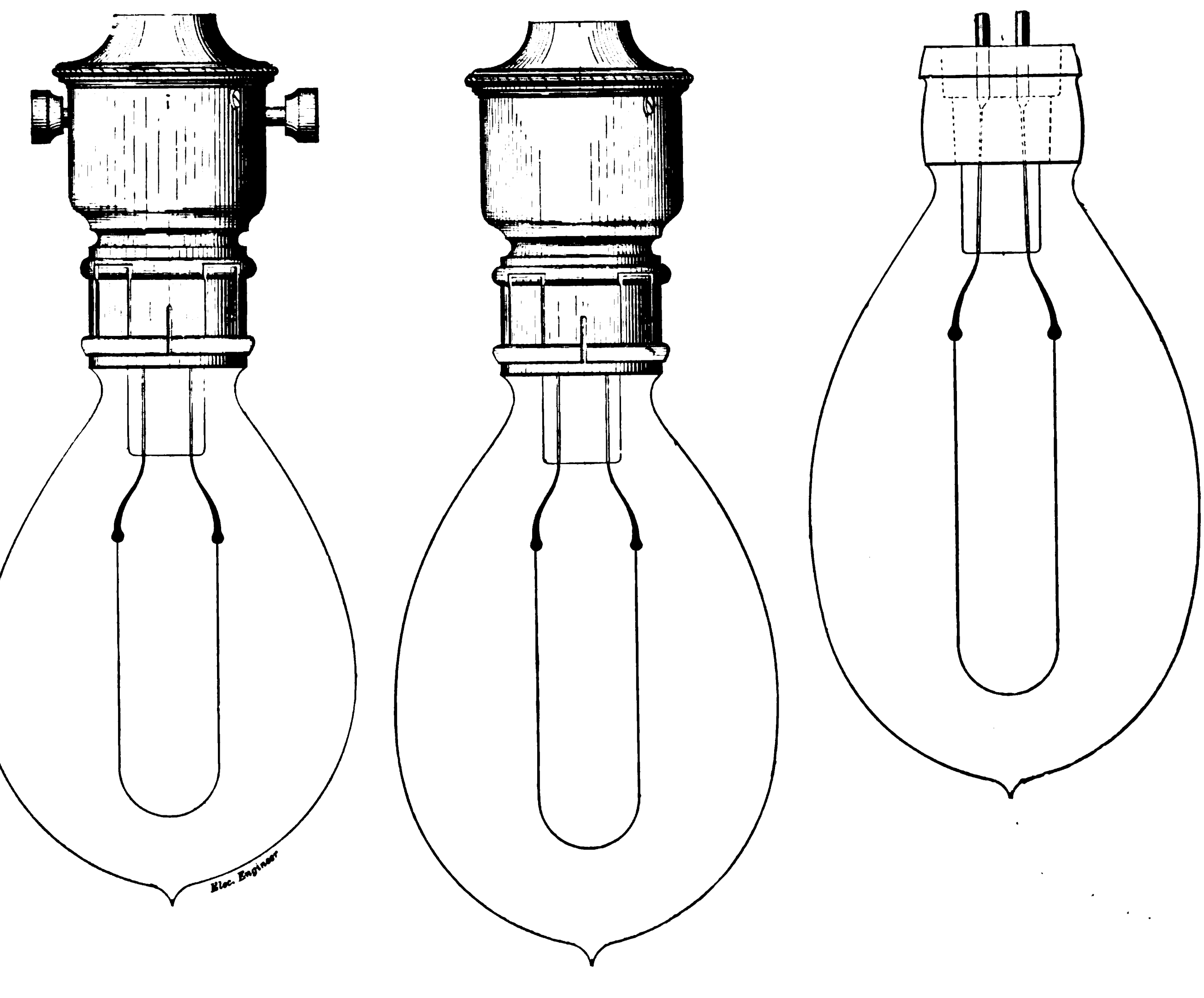
There has been considerable development done on this property by its former owner Mr. R. M. Jones, and this is the first installation to be undertaken by the company. The company also own all of the property formerly owned by the Granite Paper Mills Co. consisting of 1,100 h. p., which has been in use for years until recently when the mills were destroyed by fire, and it is now their purpose to utilize this power by electrical application and transmit it to the city, a distance of 11 miles, uniting the circuits from this station and from "The Stairs" and conducting them to the city over the same pole line. The company also own a large amount of valuable lands and improved property near the mouth of the cañon, and the water-power known as "Mill B," still further up the cañon, and 17 miles from the city. The water rights controlled by this company in fact comprise all of the available water-power of any value within 35 miles of Salt Lake City.

The franchises for the distribution of electrical energy through all the streets in Salt Lake City, and through the county to reach the city recently granted to Mr. R. M. Jones, and the city franchise for electric railway in the city and over the county roads to reach Cottonwood Cañon recently granted to Messrs. W. H. Rowe, R. M. Jones and others, are now the property of the company. They will continue the development of the water-power during the winter and intend having all materials for the completion of the construction delivered aud ready for use early in the spring both for the transmission of power and for the electric railway. The electrical and mechanical construction will be done under the direction of Mr. Jones, who intends to complete both systems within ten months.

The officers are John W. Donnellan, president; W. H. Rowe, vice-president; George M. Cannon, secretary; George M. Downey, treasurer, and R. M. Jones, general manager.

NEW LOW VOLTAGE LAMPS OF THE WESTINGHOUSE COMPANY.

The experience of the past has shown that to obtain the best illuminating effect the light-giving units must be distributed as evenly as possible over the space to be illuminated. An apartment requiring a certain candle power for its illumination, therefore, will be lighted the better, the greater the number of lamps employed and distributed, whose aggregate is equal to the required candle power. One of the most convenient and economical methods of effecting such distribution of light is to employ low voltage lamps, the use of which with alternating currents is now an easy problem. This has been thoroughly recognized by the Westinghouse Co. who are now bringing out special types of low voltage incandescent lamps, some of which are illustrated in the accompanying engravings. In these Fig. 1 represents a 20 c. p., 37 volt lamp with key socket; Fig. 2 a 25 c. p., 37 volt lamp with keyless socket; while Fig. 3 shows a 32 c. p., 37 volt lamp without socket or base. Fig. 4 shows a lamp similar to that illustrated in Fig. 1 and adapted for placing in the



Figs. 1, 2 and 3.—New Low Voltage Lamps of the Westinghouse Company.

Sawyer-Man socket. These lamps, which are all of the Westinghouse two-part type, taking only 87 volts, can be used on 110 volt circuits, as well as lamps of 50 volts and 16 c. p., of the same type as that shown in Fig. 3. It has been a well-known fact that low voltage lamps can be run at higher economy than those of higher voltage, and the coal consumption reduced accordingly.

The announcement of the new system and reduced lamp

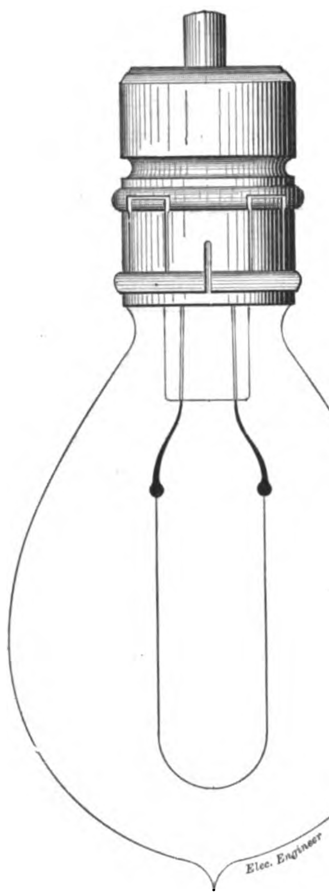


FIG. 4.—NEW LOW VOLTAGE WESTINGHOUSE LAMP.

prices will be issued by the company early in January. We understand that the list price for lamps will be 25 cents, subject to discounts for quantities, and that an allowance will be made for returned bulbs.

LIGHTING FROM INVERTED ARCS.

OUR attention has been drawn to the fact that the interesting method of illuminating interiors by inverted arc lamps, illustrated in THE ELECTRICAL ENGINEER of Dec. 13, is by no means new in principle, although it is true that its application has been but recently attempted. The benefits of this method of illumination were long since recognized by Mr. Luther Stieringer, the well-known expert in all matters pertaining to illumination, who as far back as 1882 obtained a patent covering this method of illumination. This patent, No. 253,955, Feb. 21, 1882, shows an arc lamp surrounded below and at the sides by an opaque septum. The rays projecting upwardly from the lamp are intercepted by a broad reflecting hood which throws them outward and downward and thus gives a uniformly diffused illumination, leaving the eye entirely free from the intense direct rays. It might be interesting to record here that indirect lighting of this sort was contemplated in some parts of the World's Fair night illumination, but owing to lack of time and for other reasons, the plan could not be carried out.

SOME interesting experiences are depicted in the illustrated article "A Cruise on a Monitor," by D. McFarlan Moore, in the current issue of *Frank Leslie's Monthly*. This cruise is of interest to electricians because it saw a striking demonstration of the practicability of the use of electricity for the steering of ocean vessels.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—II.

BY PROF. GEORGE FORBES.

BUT the most obvious advantage of low frequency is the improved efficiency of motors. I have arrived at this conclusion from my own observations, but I find it confirmed collaterally. With synchronizing motors, of course, the fact has long been thoroughly established that the performance is very much improved by using low frequencies. Again, those who have used the motors with rotating field of the two-phase or three-phase type have all been obliged to reduce the frequency of the current to get the best results. In this connection I am pleased to be able to give the results of some tests which were made for me of a three-phase motor at 41 complete periods per second, and at 56 periods per second.

At 56 periods the maximum efficiency is given when the output is 17 h. p. It is then 85 per cent., and the efficiency at 41 periods per second at the same output is 87 per cent. But the efficiency at the latter frequency goes on increasing until the output of the machine is 19½ h. p., when the efficiency rises to nearly 88 per cent. Thus, by lowering the frequency from 56 to 41 periods per second, not only had the output of the motor been increased 15 per cent., but the efficiency had also been increased 3 per cent. It is also found—which is a matter of the greatest importance—that in every self-starting alternating motor, whether multiphase or otherwise, the effort at starting is increased by lowering the frequency.

Again, I find that the ordinary direct-current motor with a laminated field works extremely well with low frequency; even without lamination of the field it works, though not well. I have consulted nearly every electrician of experience in this direction whom I have met during the last year or two, either in Europe or America, on this point, and they generally agree with me that the facilities of working motors of whatever kind are very much greater with a low frequency. Last year, being aware that Prof. Anthony had experimented considerably in the direction of series-wound motors with laminated field, I asked him his opinion, and he expressed himself as follows:

> In reply to yours of August 30th, I have built two or three continuous-current machines with laminated fields to run with alternating currents, and have succeeded in running motors of about one-eighth h. p. directly from the Westinghouse converter, where the frequency is some 130 per second. Such small machines run very nicely where the alternations do not exceed 25 per second. In fact, so far as I have tested, they seem to give an output fully equal to what they will with continuous currents. Of course, with high frequencies the self-induction of the field is against their working, but at 8 per second I should say that large motors could be run with perfect success.

I wish to repeat that, from what I have seen in the workshops of all advanced electricians in the last year or two, I am confident that in the near future single-phase alternating-current motors, self-starting on full load will be largely used; and there is not the slightest doubt that all of these work far better with low frequencies. In fact, as Mr. Brush once said to me when I was discussing this matter with him, "Really, your best plan would be to lower the frequency so much that you get a direct current."

Whilst speaking of low frequency in relation to motors, I must say that I have much greater hopes of obtaining a good commutating device with a low frequency than with a high one; and I will also state that I have great hopes of important advantages coming to us from the invention of such a commutating appliance which will enable us to furnish street railway companies, electro-metallurgical works, and other consumers with the direct current without the use of any heavy revolving machinery at the transforming station.

I am not sure that it ought not to be said that the greatest advantage of low frequency is in connection with the conductors used for transmission, and in the parts of the apparatus that require high insulation. When a high frequency is used there are certain difficulties which are well known. The first of these has been strongly urged by Lord Kelvin, namely, that when using large conductors an alternating current of high frequency tends to confine itself to the outside of the conductor, thus increasing the total resistance. Attention was first generally directed to this subject by the Presidential Address of Prof. Hughes to this Institution. A second difficulty is that with high frequency the impedance of the line due to the magnetic field formed between the go and return wires may amount to a very sensible quantity. Attention has been drawn to these matters by Mr. A. E. Kennelly and his Paper[1] on the subject should be carefully studied. Then, again, with high frequency there is a greater tendency to discharge from an electrified conductor into the air. This means that the insulating of a bare conductor is more difficult with a high than with a low frequency. Lodge and others have made this very manifest with exceptionally high frequencies, but the truth of the statement is well known by those who have experimented even with lower frequencies. Another trouble is that, whenever it is necessary to use solid insulation, a current of high frequency has a greater tendency to injure the insulation. Mr.

1. "Impedance," by A. E. Kennelly, American Institute of Electrical Engineers, April 18, 1893.

Tesla has shown and explained so clearly the rapid deterioration of solid insulation by currents of enormously high frequency, that we cannot fail to see that advantage is gained by using currents of low frequency. Another very important fact is that with low frequency we are less troubled by the capacity of cables, and we have less loss of static charge accompanied by heating of the insulaton. Again, the serious troubles which have been encountered at Deptford and elsewhere, owing to abnormal rises of electric pressure in the mains above the pressure generated by the dynamos, due to the resonant effect produced by the capacity of the cable and the self-induction of the circuit, may be reduced as much as we please by sufficiently lowering the frequency. All these facts are the explanation of what has been thoroughly established in actual practice, namely, that there are difficulties on the line when using high frequencies which tend to loss of power and to destruction of the insulation, and that these difficulties are largely mitigated, if not entirely obviated, by reduction of the frequency. It must also be remembered that, if we reach a frequency as low as 16 periods per second, any induction in neighboring telephone circuits is utterly inappreciable by the ear. Finally, all eddy-currents diminish as the square of the frequency. Having now stated, as clearly as I can, what seemed to me the principal advantages of low frequency, I shall place on the other side the disadvantages.

Besides the increased cost of transformers there is one fact which is apt at first sight to impress one as almost fatal to the employment of very low frequency, but which further consideration shows to be of little moment in the case of Niagara Falls: this is, that a low frequency is not suitable for electric lighting directly. But it must be remembered that it is decidedly preferable to use a direct current for arc lamps, and, in fact, in the present position of the art in America it would be almost a necessity. Hence the natural method of arc lighting would be to use the alternating current by means of a motor to drive the well known arc lighting machines. In the course of the work at Niagara the first work in connection with arc lighting which will be set up is the lighting of Buffalo. At present this is done by means of steam engines, developing about 3,000 h. p., and driving arc lighting machines of the Brush, Thomson-Houston and Wood types. There cannot be a doubt that, financially and practically, the best way of converting this station to enable them to use the power from Niagara Falls is to put in alternating motors in the place of the steam engines; and this will be the case in most of the towns which will be supplied with power from Niagara Falls.

It will be well at this point to say something about the frequency which is required to prevent the arc and incandescent lamps from flickering, I have made a number of experiments on these points, and my conclusions are as follows:—A 16 c. p. 50 volt incandescent lamp shows a flickering almost up to 25 periods per second, at which frequency the flickering ceases when at its normal brightness; but if pushed to an excess of incandescence, the flickering was just perceptible up to 27 or 28 periods. I believe that a 100-volt 16 c. p. lamp shows a perceptible flicker up to 28 periods; but I may mention that this flicker is not nearly so serious or perceptible as that which frequently arises from the employment of certain types of engines, especially single-acting high-speed engines, when sufficient fly-wheel momentum is not provided. As a case in point, I would mention the lighting in the Holland House, one of the best hotels in New York, where, to an experienced eye, the flicker of the lights in the large dining-room from this cause is very objectionable. The thinner the filament, the more liability is there to such a flickering. I have lately examined the thick filament lamps to which the name of "Bernstein" lamps has been given, which consume 6 to 10 amperes at low voltage. It takes so long a time for the incandescence to die out when the current is stopped, that I have little doubt about their being able to work without any perceptible flickering at so low a frequency as even 16 periods per second. I have also made some experiments of a similar nature on arc lamps at low frequencies. At 37½ periods per second there was very bad flickering, and this was most noticeable when looking at a piece of white paper illuminated by the naked light, or when looking at an opal shade put on the lamp. At 40 periods it was still bad. Neither at this speed, nor at the previous one, was there any serious noise, but at 40 periods the noise could be perceived by putting a glass globe over the lamp resting on the metal framework directly. At 41.7 periods there was just enough flickering to be objectionable; at 45 periods it was just possible to notice it on a printed page held close to the lamp, but it was not visible when reading at a distance of 10 ft. At 50 periods the only means of detecting anything of the sort was by looking directly at the arc; nothing was seen when reading a book, either with the opal shade on or off. At this frequency the noise became much more perceptible, especially with a long arc about one-eighth of an inch. On reducing the length of the arc to one-sixteenth of an inch the noise was much less. In all these experiments the consumption of energy was at the rate of 26 volts and 14.2 amperes at the lamp terminals. The best cored carbons of Siemens and Halske were used.

An objection has been raised to the use of low frequency owing to the fact that a periodical twisting strain is given to the shaft of the dynamo, but this objection disappears almost entirely when we are dealing with a machine generating two phases.

It follows, therefore, for arc and incandescent lighting at a very low frequency it becomes necessary to use alternating-current motor generators, or else to use something of the character of a commutating machine to convert into continuous currents. Such machines are those exhibited by Schuckert at Frankfort in 1891 are useful up to a certain extent, but they are expensive, and comparatively inefficient, as their only function is to commutate the current—an operation which ought not to involve any significant loss At the present moment a good commutator for the alternating current is not upon the market, but the matter is of such prime importance that I feel confident that much will be done in this direction. In fact, I have seen enough with my own eyes to have no fear about our being able to generate continuous current from the two-phase alternating current without serious loss, and with very inexpensive machinery. If, however, the object of our work was mainly, or even to a considerable extent, to provide the means of lighting towns by arc and incandescent lamps, I should have hesitated to recommend a reduction in frequency below 42 periods per second, such as used by Ganz and Co., and which is operated so successfully at Rome and Tivoli, and at a very large number of other places on the Continent. The officers of the company and myself considered this matter most carefully, and, looking at the purposes for which our machinery is being set up, we felt sure that the proportion of electricity which would be used for lighting purposes would not be large, and that we must look upon our whole plant as a power producing and distributing plant, and that our object must be to distribute power in the most efficient and economical manner. This being the case, we agreed that it was desirable to lower the frequency so far as the mechanical conditions of the problem would allow. The lowest frequency which had been offered to us by the manufacturers was a very beautiful design of a machine at a frequency of 20 periods per second. This machine had admirable qualities, but was in some points not exactly adapted to the requirements of the situation, as developed by the selection of a special design for the turbine.

I have myself made several trials of designs at very low frequencies, even as low as eight and one-third periods per second, and for this frequency I prepared drawings of a machine which, by no means perfect, shows a possibility of being worked into a sound machine of good mechanical construction; but further considerations led me entirely to modify the design of the machine, and eventually I arrived at the conclusion that, both from the point of view of design of the dynamo, and also for suitability of applying the current, 16 periods per second was probably as good as could be obtained. The manufacturers to whom the contract has been given were anxious to use a lower induction in the iron of the machine than that which I would have preferred, and this rendered the machine of 16 periods per second heavier than could be supported by the hydraulic piston which supports the whole weight of the turbine, vertical shaft, and revolving part of the dynamo. Consequently we have made a compromise, and are going to build our first three dynamos with a frequency of 25 periods per second. In concluding my remarks upon low frequency, I must again repeat that, from a purely practical and commercial point of view, one of the great advantages lies in the fact that for any special purpose for which a motor is required any ordinary direct-current motor may be altered so as to act as a synchronizing alternating motor at a very small expenditure of time and money.

ELECTROMOTIVE FORCE.

The question of selecting a suitable electric pressure for working to Buffalo, and also for local purposes, is of some importance. Generally speaking, it is desirable to use as high an electric pressure on the line as is consistent with safe and continuous working, As this effects a great saving in the amount of copper used on the line. In the first report, founded on insufficient data, which I wrote more than three years ago for the Cataract Construction Company, I recommended that 2,000 volts should be used in the neighborhood, and that the pressure should be raised by means of transformers for the more distant transmission. But the greater portion of our work in the immediate future will have the character of distant transmission. In most of the tenders which were submitted to us the cost of transformers was almost as much as that of dynamos, in some it was more, so that the use of a step-up transformer for distant transmission meant almost double the cost of generating the current. I hold the view that a pressure of even 20,000 volts can be generated as safely in the dynamo machine itself as in the transformers, and that if we used 20,000 volts for the local work as well as for Buffalo we should not be incurring the additional expense and losses of a step-up transformer, while we should be saving enormously in the cost of copper. Unfortunately, American manufacturers have never supplied alternating-current dynamos at a higher pressure than 2,000 volts, and they are not practically acquainted with the experiences which have been gained in Europe at extra high pressures. Most of the manufacturers declared their inability positively under any conditions to go above 2,500 volts, although some of their engineers

were willing to go as far as 5,000 volts. This, however, would have been no material gain to us; and the consequence is that to meet the views of the manufacturers in our preliminary work—that is to say, in the construction of the first three dynamos for our power-house—these will be only of such electrical pressure as they are accustomed to deal with. We shall, therefore, be using dynamos generating current at 2,000 volts, and employing step-up transformers for the extra high pressure. This may possibly render it desirable in our first work not to use the extra high pressure for local purposes. Besides the actual cost of the conductors a very serious matter arises when we are dealing with the large currents due to comparatively low electric pressure. I refer to the large quantity of copper which has to be put into the conductors. Working at 2,000 volts, each phase of each of our generators will give nearly 1,000 amperes without considering the effects of retardation of phase, which will increase the current by quite a perceptible amount. So that to put in the most economical section will require 3 sq. in. for each conductor or 12 sq. in. of of copper for each 5,000 h. p. dynamo, or 36 sq. in. section of copper for the 15,000 h. p. which is now being supplied. When we remember that even with low frequency the question of skin resistance comes into play when the conductors have a large diameter, it is obvious that we are introducing serious troubles, and if a subway were to be made to carry these conductors it would require to be of very great dimensions. For these reasons, I am still anxious to see the extra high pressure used, even for the factories within a distance of a mile. The uniformity of the system would undoubtedly be of great benefit to us if we could generate the whole current for all purposes at the same extra high electric pressure; but, as I have stated, we were obliged to content ourselves with a somewhat less perfect arrangement than would be adopted if we were dealing with the utilization of a waterfall in Europe.

I wish to lay stress on the importance which I have considered to lie in the fact of having a perfectly uniform system with interchangeable dynamos. Many engineers to whom I have talked have suggested the use of special dynamos at different pressures for special purposes; but if we had a special dynamo for arc lighting, and another for incandescent lighting, a third for street railways, another for electro-deposition, and so on, the possibility of interchanging dynamos would disappear, and the whole system would be much more complicated to work.

I wish now to make a few remarks about the insulation which it has been customary to put upon dynamos and transformers which were to be used with high electric pressure. Many persons who have not given sufficient attention to the subject seem to be inclined to believe that there is something mysterious about the tendency of electricity in a dynamo or transformer to break through the insulation and which prevents them from being subject to the ordinary laws of electricity. Thus, when building a dynamo for 2,000 volts a thickness of insulation is given which would stand a test of more than 100,000 volts without breaking down, and it has been found from the ordinary methods of using the plant that if something of this sort is not done the insulation will break down. I wish to point out that the reason for this lies in the fact, not that the insulation breaks down with 2,000 volts, but that in a 2,000 volt system, as generally used, electromotive forces are occasionally generated amounting to 100,000 volts or more. These abnormal rises in electric pressure are chiefly due to the resonant effect, which has received so much attention of late years, and may be caused by the sudden breaking of the circuit of the dynamo. If these causes of excess be avoided, the electric pressure will never rise above the working pressure, and the insulation will never break down, even though its thickness be only little more than sufficient to stand a test at the working pressure. Dr. Fleming has shown us how to kill the resonant effect, and such a phenomenon never appears now at Deptford. This trouble may also be avoided by having as little capacity on the line as possible, especially when combined with low frequency. As to the cause of trouble mentioned above, I hold that it is a piece of culpable ignorance, ruinous to the machinery, if anyone should ever, on a large power circuit with alternating current, suddenly break the circuit while current is passing. This practice is quite unnecessary, and has given rise to a large proportion of the breakdowns of alternating-current machinery.

WESTERN UNION QUARTERLY FIGURES.

The directors of the Western Union Telegraph Company have declared the regular dividend of 1¼ per cent., payable January 15. The statement made no reference to the falling off in earnings. The estimated decrease in net revenue is $456,000 for the quarter compared with the preceding year. The surplus after dividends decreased $449,677, the surplus being $121,738. The gross surplus was reduced $1,638 during the quarter on account of the capitalization of 16.38 shares, bringing the outstanding capital stock to $94,820,000. The book surplus, after providing for the dividend declared, stands at $7,329,917. Estimated earnings on the stock for the quarter were 1.37 per cent., on the outstanding capital.

ALTERNATE CURRENT ELECTROLYSIS.[1]

BY J. HOPKINSON, D.SC., F.R.S., E. WILSON AND F. LYDALL.

Suppose an alternating current to be passed through an electrolyte between electrodes, and that the current passing and the difference of potential are measured at intervals during the phase. If the electrolytic action were perfectly reversible, we should expect to find the potential difference to have its maximum value when the current was zero, that is to say, when the total quantity of electricity had also a maximum value. One object we had in view was to ascertain if this were the case, and, if not, to determine what amount of energy was dissipated under different conditions.

This is readily done, inasmuch as the work done on the voltameter or by the voltameter in any short time is the total quantity of current passed in the time multiplied by the potential difference. Let a curve be drawn in which the ordinates are the coulombs and the abscissæ the volts at corresponding times, the area of this curve represents the work dissipated in a cycle.

Part I.—In the first instance, two cells having platinum plates for electrodes were used. They have each an area of 150 sq. cm. exposed to one another within the electrolyte, and are placed in a porcelain vessel ⅛ inch apart. Pieces of varnished wood were placed at the back of each plate so as to prevent conduction between the outside surfaces through the fluid. The solution used was of water 100 parts by volume, and H_2SO_4 5 parts. By means of a two-way switch one of Lord Kelvin's quadrant electrometers could be placed across the cells, or a non-inductive resistance through a revolving contact-maker, fixed to the shaft of an alternator. A condenser of about 1 m. f. capacity was placed across the terminals of the electrometer.

From observations of the values of the E. M. F. across the cells at different times in a period, a curve was plotted, giving potential in terms of time.

In the same way another curve was plotted for the E. M. F. between the terminals of the non-inductive resistance, giving the current in terms of time. Hence the area of this curve up to any point, *plus* a constant, is proportional to the quantity of electricity corresponding to that point.

The area of each curve is a measure of the energy dissipated per cycle, and since in this case there can be no accumulation of recoverable energy at the end of the cycle, it follows that the *whole* difference between what is spent during one part of the process, and what is recovered during the other part is dissipated.

Part II.—In the next set of experiments the frequency was varied, in addition to current; and in order to allocate the losses of potential in the cell, the platinum plates were placed ¼ inch apart for the purpose of introducing an electrode into the fluid between the plates. This electrode consists of a platinum wire sealed into a glass tube which was capable of being placed in any desired position between the plates. The solution was, as before, of water 100 parts and H_2SO_4 5 parts by volume.

Instead of observing the potential between the two platinum plates, observations were taken of the values of E. M. F. between one plate and the exploring electrode.

From observations of the values of E. M. F. between the exploring electrode and the platinum plate at different times in a period, a curve was plotted, giving potential in terms of time. This curve is peculiar, in that the ordinates at corresponding points in the two half periods are not equal to one another, as is the case in the one which gives the potentials across the two plates.

This curve gives, at any epoch, the potential taken up in the evolution of gas at the surface of the plate, *plus* the potential due to the current in overcoming the resistance of the electrolyte itself. To separate these quantities experiments were made upon the resistance of the electrolyte for varying frequencies and currents. To this end the plates were placed about 2 inches apart in the fluid, and two exploring electrodes, as already described, were placed within the fluid in a straight line drawn perpendicularly between the faces of the plates, the distance between the electrodes being 4.3 cm. Some difficulty was experienced, owing to the gases being given off at the plates more rapidly in some cases than in others. We, however, estimate that the resistance of a layer of the electrolyte, of a thickness equal to the distance between the electrode and plate, and of area equal to the area of the plate submerged, was approximately 0.0056 ohm.

From observations on the direction in which the electrometer needle was deflected for a given position of a Clark's cell connected to its terminals, we were able to state which gas was being given off at the plate.

A general conclusion of the experiments is that about one-tenth of a coulomb suffices to fully polarize 150 sq. cm. of platinum. This will liberate 0.00001 of a gram of hydrogen; hence 0.00000007 gram of hydrogen serves to polarize 1 sq. cm. of platinum. 0.00000007 cm. is probably a magnitude comparable with the distance between molecules of hydrogen when this body is compressed to a density comparable to the density of liquids.

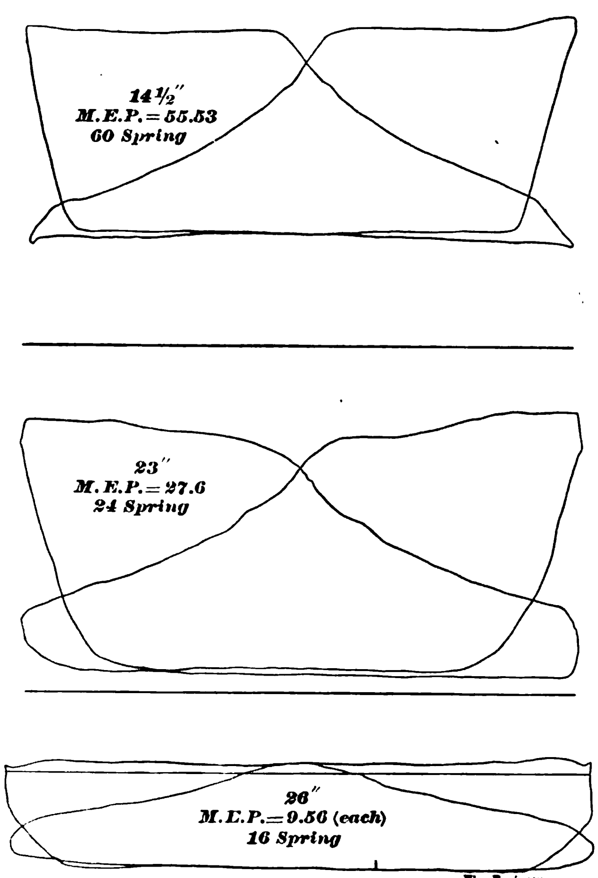
1. Abstract of a Paper read before the Royal Society, November 2, 1896.

TRIPLE EXPANSION ENGINES IN ELECTRIC LIGHTING STATIONS.

OF the many problems of interest to the central station managers, one of the most important is, How far can one go in the direction of multi-cylinder engines, and by so doing, effect a saving in fuel commensurate with the greater cost of installing this class of engines? An increase in the number of cylinders narrows the limits of economical working, and the more variable the load, the less is the saving which can be effected by their use. The question is, When do they pay?

In the largest cities, in stations for incandescent lighting, it has been found that triple expansion engines are perfectly feasible and effect a large saving. This work, of course, is of a very favorable nature, enabling the units to be always kept well loaded. In smaller cities, however, and where the work is of a varied kind, such as arc, incandescent, or motor work,—generally a combination of the three,—there has not been much done in this line, and it has been considered by most engineers that the efficacy of using triple expansion engines as a means of saving coal is somewhat problematical on account of the variable load generally found in such stations; while all concede that if this class of engines should prove to be coal savers to a considerable extent, their use is greatly to be desired, and will help towards placing many stations of this kind upon a good paying basis.

We are glad to present to our readers in this issue, a reproduction of some indicator cards taken from a triple expansion engine in such a situation of this kind which shows splendid results in fuel economy. The station in question is that of the Elmira Illuminating Co., Elmira, N. Y., which we illustrated and described in our issue of Aug. 23, 1893, and which is entirely the design of the efficient general manager, Mr. F. A. Cheney. The engine was built by McIntosh, Seymour & Co. of Auburn, N. Y., and is of the vertical four-cylinder triple expansion type, of a nominal capacity of 500 h. p. In this station the day load consists of motor and electric railroad circuits only, which

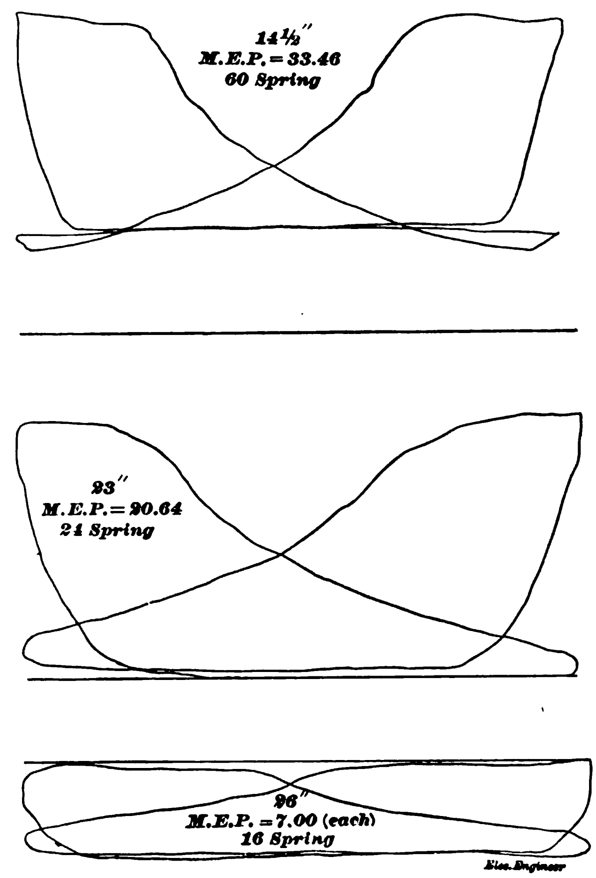


Initial Pressure, 139 lbs.; Revolutions, 139; Horse Power, 518.69.

FIG. 1.—MAXIMUM STATION LOAD—INDICATOR CARD FROM MC INTOSH, SEYMOUR & CO. TRIPLE EXPANSION ENGINE.

are run from separate horizontal compound engines. The 500 h. p. triple expansion engine is started when the lighting comes on, and runs until midnight. From midnight until morning a smaller horizontal triple expansion engine carries the lighter load, which is pretty nearly constant, consisting largely of arc lights. The accompanying cards, taken from the large engine, show the minimum and maximum loads under which it runs, the light cards giving the Sunday evening load when lightest, and the heavy cards being taken slightly before six o'clock when both store and house lights are on, and the load is heaviest.

It can readily be seen that in both of these extreme cases, the engine is working under favorable conditions as regards economy of fuel. The lateness of the cut-offs which occur in triple expansion engines impose a very difficult duty on the governor of the



Initial Pressure, 137 lbs.; Revolutions, 140; Horse Power, 374,62.

FIG. 2.—MINIMUM STATION LOAD—INDICATOR CARD FROM MC INTOSH, SEYMOUR & CO. TRIPLE EXPANSION ENGINE.

engine, much more so than is common in single cylinder and compound engines by reason of the greater range through which it has to act. Upon this engine, at full cut-off, which is at $\frac{5}{16}$, the speed only falls off three turns, about 2 per cent. from that when the engine is running with no load, and condensing, which is certainly a very remarkable result. It will be noted that by having the cut-off valves operated by the governor, the receiver pressures and the drop of temperature in the cylinders is kept practically constant, and the economy of the engine is always the best obtainable for the conditions under which it is running without any hand adjustment of the valves being required.

As to practical results, comparing the percentage of the coal bill to the gross receipts of the company from business shows a saving in fuel of 61 per cent. as compared with results obtained in the old station, comparison being made between the results obtained during the months of November this year and last, which should give as fair a test as is possible.

As to the question of desirability of vertical engines at least as far as this particular engine is concerned it is significant that the only fault that the owners have to find with this engine is that it runs so smoothly and is so easy to care for that they find it hard to prevent the engineers from running it during the hours of light load instead of the smaller engine provided for that purpose.

NEW YORK EDISON CO.'S EARNINGS.

THE November report of the Edison Electric Illuminating Company shows gross earnings of $121,701, an increase of $20,642. The net earnings were $65,585, an increase of $18,692. For the eleven months to November 30, the total gross earnings amounted to $1,078,369, an increase of $238,601. The total net earnings for the eleven months amounted to $506,710, an increase of $94,641.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XVI. NEW YORK, DECEMBER 27, 1893. No. 295.

MUNICIPAL CONDUIT SYSTEMS.

THE possible and even necessary developments of the "municipal control" idea, in electric lighting and other things, are numerous and wide reaching. An evidence of the lengths to which a municipal plant system may be logically carried is afforded by the action taken recently at Cambridge, Mass., where the aldermen not only favor a municipal station but want an extensive conduit system also. They ask for State legislation enabling cities and towns in Massachusetts to establish conduits in the streets, for wires and cables, and anyone using the conduits to pay a rental that shall ensure a return of not less than 10 per cent. on the amount invested. It seems to us that this is going a long way in the expenditure of money raised by taxation and in the creation of public debt; but if the community makes no objection to such burdens nor to the increase in the number of public officials, there is little to be said by outsiders. We can only repeat our conviction that such outlay is unwise for a city, and that in the end it will be found much better to leave such investments to private enterprise, under proper restriction and supervision. It is urged that the city will enjoy closer control of its own streets if it is the proprietor of the conduits, but we have not noticed any loss of control in New York, where the Subway Board is entrusted with the regulation of the status toward each other of the city, the subway company and the various service companies; and where no citizen has been taxed or loaded with more public debt, to accomplish purposes for which private funds have been readily available.

FURTHER REDUCTION IN LAMP PRICES.

REDUCTION in lamp prices seems to be in the air. The Westinghouse Company cut down prices a year ago when they brought out their stopper lamp; and they are, we learn, about to make a further reduction in putting out their improved low-voltage lamps, of which we give some account, with illustrations, elsewhere in this issue. The list price, we understand, will be 25 cents, with discounts for large quantities. A liberal credit will be made for bulbs returned by consumers. The new lamps and new prices may be expected at about the beginning of the new year. Let the good work go on.

SELF-INDUCTION AS A REMEDY FOR STATIC DISCHARGE.

THAT the interest in any method designed to increase the speed of telegraph and cable working, especially the latter, is still as keen as it ever was, is made evident by the attention which the paper read by Prof. S. P. Thompson before the Electrical Congress attracted, and by the communications on the same subject which have recently appeared in THE ELECTRICAL ENGINEER. In all of these the authors showed in what way self-induction might be employed to overcome the effects of static discharge, and they exemplified the extent to which actual practice had proven this remedy to be effective. In referring to the articles appearing in the ENGINEER, the London *Electrical Review* expresses the regret that the information vouchsafed by those who have had practical experience in these matters is so indefinite. As a remedy for this state of affairs, it inquires, why those who have access to artificial cables cannot make a simple experiment which would clear the ground, in view of the fact that artificial cables equivalent to a length of 1,000 or 2,000 miles are not very rare. "Why," says our contemporary, "could not the experiment be made of putting on to such a cable, say, 10 leaks of 10,000 ohms each, and see what effect is produced on the signaling." There is no reason whatever why this could not be done, if it has not already been tried, but we doubt whether any cable electrician of experience would consider as anywhere near conclusive any results obtained exclusively on an artificial cable. The mistakes, many of them of a costly nature, which have been made in the past, where reliance has been placed in the results obtained with artificial resistances and capacity are not, as a rule, matters of record, but they are none the less matters of common knowledge; and indeed form a part of the personal experience of not a few electricians. Just why an artificial cable, such as that of the Muirhead type, for instance, should not be the equivalent, in every respect, of an actual cable has not yet, we believe, been satisfactorily explained; but that, as a matter of fact, it is *not* such an equivalent, will, we believe, be found to be the case on actual trial. We do not by this mean to convey the impression that artificial lines are worthless for purposes of experimentation, for their employment when used in connection with land line, or more specifically serial, work has frequently aided investigators and their use for that purpose is steadily increasing. Even in such cases, however, prudent experimenters make due allowances. But for long cable work the absolutely equivalent artificial substitute is still something to be worked out, and indeed may well occupy the attention of inventors.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE CASS AVENUE AND FAIR GROUNDS RAILWAY, ST. LOUIS.

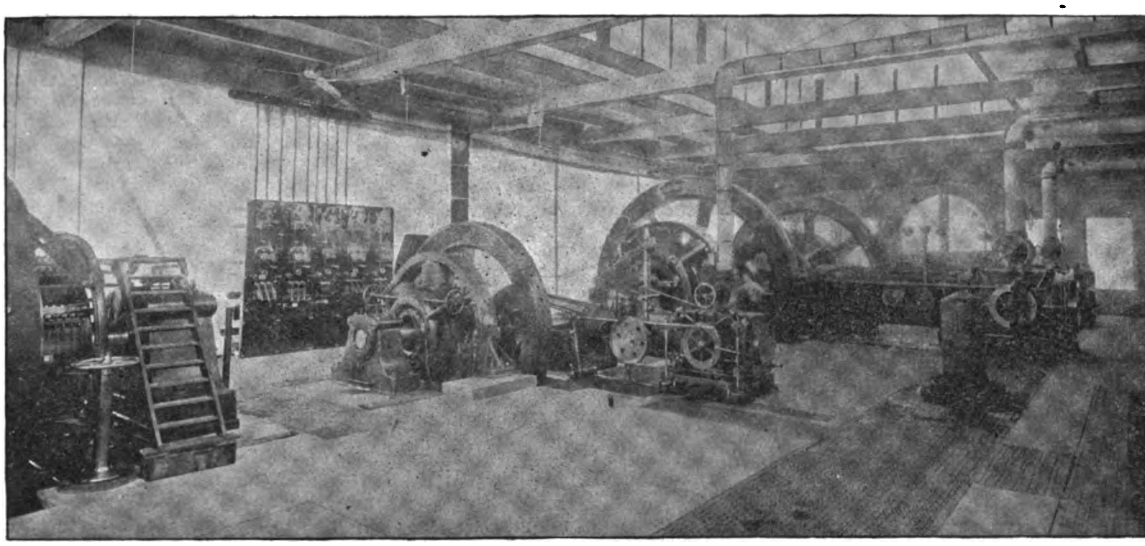
In 1892 the old Cass Avenue line of St. Louis, was consolidated with the Northern Central and Union line, and became the Cass Avenue and Fair Grounds Railway, changing with its name the method of its car traction, from the horse to the electric motor. The new company, proceeding along lines dictated by business acumen, has installed a model power station, and is operating a road which for perfection of construction and operation has few rivals.

The length of the road under the old horse régime was twenty-seven and a half miles; the adoption of the improved methods, however, speedily developed the line, which is now thirty-five miles long, and over which are operated seventy cars, built in the car shops of St. Louis Car Co.

The power-house is a substantial brick structure, with a frontage of 168 feet on Prairie Avenue. It has a depth of 164 feet, and in location, construction and disposition is peculiarly well fitted to its uses. The engine room measures 164x58 feet, and with General Electric apparatus of the usual type, and is also provided with automatic circuit breakers with electrical reset.

The overhead and line appliances are exclusively from the General Electric shops. The track is built in a substantial manner, and laid with a Johnson 85 lb. girder rail, with supported joints, the ties being laid twelve to the rail. Johnson tie plates are also used, but no chairs. The curve rails are 100 lbs. and the poles were made by the Walworth Manufacturing Co.

Each of the seventy cars is equipped with General Electric motors and type E and K controllers, and their operation has not only given satisfaction but has also elicited high praise. Of the operation of the road as a whole, Mr. McCulloch, vice-president and general manager says: "We have not had an instant of delay, and only such trifling trouble as are incident to the handling of new machinery by inexperienced men. I attribute our successful start in electric life to the excellence of the electrical apparatus and devices you have given us. We have operated thus far with absolute freedom from electrical annoyances, and if our plant were to be duplicated, I see no reason why we should make the slightest change from the present one."



Power House, Cass Avenue and Fair Grounds Railway, St. Louis.

the boiler room 164x50 feet. Between them is a roadway eight feet wide, which runs the entire depth of the building. The room above this is used for storage purposes. In the boiler room, which is twenty feet below level, set in pairs are six down-draft return tubular boilers built by the O'Brien Boiler Works of St.Louis. These are 22 feet by 5 feet 6 in.,and have eighteen six inch diameter flues, conducting to three sheet steel chimneys, each 100 feet high. A conveyer running along the floor in front of the furnaces, and operated by a small upright engine, carries away the ashes and loads them on wagons. Two No. 7 Hooker pumps are comprised in the equipment, and the water is heated in a feed water heater of the Excelsior type.

The engine plant which is illustrated in the accompanying engraving, consists of four Reynolds-Corliss horizontal engines from the shops of the E. P. Allis Co., of Milwaukee. Three are of 1,000 h. p. each with cylinders 34 x 60 inches, and the fourth of 850 h. p., with cylinders 18 x 36 inches. The flywheels of the large engines weigh 65 tons each, and revolve at 93 revolutions per minute; the speed of revolution of the smaller engine is 150. The large engines have been worked up to 1,500 h. p. or half as much again as their indicated capacity. They take care of the day service, while the small combination is used to run the all-night cars.

The most striking feature of the station is, that it is entirely direct-connected, the belt driven machine having no place there. It resembles the model railway plant shown in the intramural power house at the Columbian Exposition. Three General Electric Company's 750 k. w. ten-pole, 100 revolution, generators are directly connected to the three large engines, and one 200 k. w. six-pole 100 revolution generator to the smaller. The generators are of the latest railway type, and like their prototypes at the World's Fair, have already come up to, and even exceeded, the specified requirements. The switchboard is equipped entirely

The Cass Avenue road may justly be considered as an excellent example of the highest recent attainment in railway practice.

TROLLEY ACCIDENTS.

In reply to Mr. McCarthy's suggestion of the hand brake, in preference to the air or vacuum principle of utilizing the brake shoe, I would like to say that when writing my former letter, the utility of the hand control occurred to me, but it was discarded for this reason, that in an emergency, *time* is a prime factor, and if Mr. McCarthy will consider that the average brake handle is from 8 to 10 inches in length, and that the motorman's hand must describe a circle of 48 to 60 inches in circumference for each turn of the chain around the brake rod, he will certainly acknowledge that some very "rapid transit" motion must take place before the car is under control, whereas, by the movement of a valve handle, externally similar to the top of the present resistance box, controlled by the motorman, the admission of air can be as carefully graduated to suit the necessity of the case, as the current is now supplied to the motors. The strain and racking feared by Mr. McCarthy, as a result of the use of the air or vacuum brake, would be entirely avoided by proper bracing of the shoe frame and toggle levers, with the running gear frame, and not with the car-body proper.

Shoeing the iron shoes with oak buffers, to take the wear of the friction, would do away with the need of sand boxes, except in a very slippery and greasy condition of the track, or in freezing weather on a heavy grade. Regarding the electric control of the brake shoe, I admit that the dependence upon the trolley or primarily the power house for the supply of current for any form of electric brake, is faulty, and when most needed, would be found

wanting. In such case the hand brake would be vastly better than none at all, even if that "none" was a so-called "electric brake."

This application of power, to be effective, should be entirely distinct and separate from the working current of the road.

RUFUS B. CRISSEY.

TROY, N. Y.

ITEMS OF ELECTRICAL INTEREST IN PEORIA, ILL.

LAST summer the citizens of Peoria and Pekin thought that there would be two electric lines connecting the two cities. There were two companies, one of which proposed to cross the river by using the wagon-bridge and go down on the other side of the river, while the other intended to go down on this side and cross at Pekin. The latter company secured the necessary franchise from the Pekin council, while the former could not secure a franchise from the city of Peoria to use the wagon bridge and come up Bridge street and connect with the Central railroad. It is now stated that the opposition of the Council in granting the franchise killed the project, as the supposed two companies were one and the same.

Last June options were obtained on both the Fort Clark and the Central railroads by the company that intended to build the Peoria and Pekin road. They intended to connect them with the latter and also to extend the lines into new territory, but the whole project has fallen through. If the two cities get a connecting line it will be built by the General Electric Company who own the Fort Clark road, and who will then build a new bridge to be used by the electric line only. They are now looking for a tract of land for a park.

The new fly-wheel, to replace the one that burst recently at the Peoria General Electric Company's works, has arrived and has been placed in position. The damages to building and dynamos have been repaired and they are now running regularly.

The Peoria Water Company have petitioned the city council not to allow any street railroad company to use ground wires for return circuits, as they claim that electrolysis is damaging their pipes. The petition has been referred to the Water Committee.

A LARGE TROLLEY CONSOLIDATION IN BROOKLYN.

AT a special meeting of representatives of the Brooklyn City Railroad Company and of Drexel, Morgan & Co., who control the Broadway system in Brooklyn, the scheme to incorporate the Broadway lines into the Brooklyn City system was accomplished. All the franchises of the Broadway road will come over to the Brooklyn City.

Bonds will be issued to cover the cost of the Broadway railroad system which is to be no more than the present owners, Messrs. Hollins and Seligman, paid to Drexel, Morgan & Co., for it. In addition there will be bonds to secure sufficient money to equip the Broadway railroad system with electricity. Mr. Lyman, one of the directors of the Broadway City Railroad says that there would probably be a little more than $5,000,000 put on the market.

The Long Island Traction Company owns or controls all the capital of the Brooklyn Heights Railroad, the lessee of the Brooklyn City Railroad. Some time ago J. Seligman & Co. and G. W. Clark & Co. consented to join with Mr. H. B. Hollins, who purchased all the capital stock of the Broadway and Brooklyn Ferry, the Metropolitan Avenue Railroad Company, and the Jamaica and Brooklyn Railroad Company, which may be styled the Broadway system, and all this the Brooklyn City is now actually in possession of. This gives the company a big slice of territory in Queens County and sends the Brooklyn City Railroad Company far across Long Island.

AN ELECTRIC FUNERAL CAR FOR SAN FRANCISCO.

"CYPRESS LAWN," the newly built funeral car of San Mateo Cemetery of that name, was built at a cost of $2,500 and is of handsome appearance. It is thirty feet in length and divided into two compartments, the forward twenty feet in length and the rear ten. The former is richly upholstered, tapestried and carpeted. Twelve plush seats are arranged to seat twenty-four persons. In the rear or funeral apartment, seats on each side capable of seating twenty are arranged for relatives and near friends. In the centre is the bier on which the casket stands.

JERSEY CITY TO NEWARK.

THE CONSOLIDATED RAILROAD COMPANY has started its cars successfully over the new trolley line between Jersey City and Newark. The fare is 10 cents and it is expected that the distance will be made on regular schedule in thirty-five minutes. There are many railroads running into and through Newark from New York whose passenger traffic will be encroached upon by the electric system. Smoking cars will be attached to some of the regular cars. The power will be supplied from Newark and Jersey City.

THE PHILADELPHIA TRACTION REPORT.

AT the annual meeting of the Philadelphia Traction Company recently held, the president, Mr. Widener, submitted his annual report of the operations of the company, which showed: Receipts, $4,286,838.55; operating expenses, $3,810,498.24; rentals, $1,283,-500.65; leaving a balance of $392,749.50.

No comparison was made with last year's figures, but the earnings are equal to about $4 per share. This is the most favorable report ever made by the company, and the prospects for next year are very bright.

MISCELLANEOUS.

TELEGRAPH AND TELEPHONE CONSTRUCTION IN THE BAHAMAS.

As supplementing the article on "Telegraph and Telephone Construction in the Tropics" by Mr. Francis R. Hart, in our issue of Nov. 22, we are glad to publish some interesting details of similar work in the Bahamas, for which we are indebted to Mr. P. H. Burns, Superintendent of Telegraphs, at Nassau:

The land line at Nassau is but six miles long and runs along the sea shore the entire length, the poles averaging a distance of about 50 yards from the water's edge. In my opinion there is not a better built line anywhere. The poles are of wrought iron and are about 25 feet high. They are made in two parts, a socket being placed five feet deep in solid rock and well cemented all the way.[1] The pole fits into the socket about three feet deep and is also cemented. The poles are set eighty yards apart, averaging 22 to the mile. Both our wires are of the best copper. The only trouble I anticipate from the line, and which is begining to show already, is that the salt air will rust the poles, as the air here causes everything in the shape of iron or steel to rust. This, however, can be overcome by chipping the rust off and repainting the poles which I think will have to be done about every two years. Should the poles be painted without first chipping off the rust, it would be labor lost, as the rust would continue to act under the paint. The brush grows very fast here and needs constant attention.

Some idea of the soundness of the line can be gained from the fact that during a hurricane here in September the entire road for two miles, along which the line runs was washed away, the tremendous waves dashing clear over the telegraph wires; yet not a pole was injured, nor was communication with Florida cut off for an instant. Had it been a line of wooden poles such as are used in the United States there would not have been one of them left. Our poles are very much like those shown in Fig. 10 of the ENGINEER'S article, the cross-arm being slightly different and each pole having a lightning rod two feet high at the top. Our cable is 210 miles long, landing at Jupiter, Florida; its depth runs from 14 to 1,800 fathoms. It is worked on the American closed circuit system similar to American land circuits and all reading is done by sound. The cable was laid by a London firm and is the property of the Bahamas Government.

There are no telephone lines here except private ones, the wires being run on housetops, etc.

A PIONEER CANADIAN INCANDESCENT PLANT.

AT a recent meeting of the Montreal Electric Club, Mr. John Smillie read a paper on an electric light plant of which he had charge in 1881 and gave a graphic description of the methods and electrical apparatus employed. This plant was one of the first in Canada and was used for lighting the St. Lawrence Hall Hotel at Montreal. It consisted of an arc and an incandescent dynamo of the old Maxim type, manufactured and installed by the United States Electric Lighting Co., of New York. The dynamos had Gramme ring armatures wound with double cotton-covered wire insulated from the armature core by press board. The commutator segments were also originally insulated from each other by press board which burnt away rapidly by the sparking and had to be renewed frequently. To remedy this objection, a noted electrician from the United States advised the substitution of asbestos paper. This, however, was not entirely satisfactory for the reason that copper dust accumulated in the pores of the paper and thus caused short circuits between the segments.

The incandescent dynamo supplied current to sixty-five 16 c.p. Maxim lamps in multiple. The lamps had carbonized paper filaments and some had a life of over 800 hours, but the greater number lasted only a few hours. One pole of the dynamo was connected to the main gas pipe in the building and one terminal of each lamp was also connected to the gas pipe so that no return wire was required. Paraffined, cotton-covered annunciator wire was run from the other pole of the dynamo to the incandescent

1. Formation of this island is coral rock.

lamps. One terminal of a lamp was connected to the wire and the other grounded upon the nearest gas pipe. As a result of this method of wiring, short circuits between the wires and gas pipes were of common occurrence and at times the paraffine covering of the wires took fire from the heat. The following incident was mentioned to show the danger arising from this cause. A short circuit occurred between a composition gas pipe and a wire passing over it. When discovered. a portion of the pipe was melted completely away; the issuing gas had taken fire and had also set fire to the floor. Another consequence of using the gas pipes for returns was that people turning on gas cocks often received shocks.

For the arc circuit, bare copper wire was used, stapled directly to the walls and ceilings of the hotel. Where the wires crossed a gas or water pipe, pieces of rubber tubing were slipped over them to prevent contact with the pipe. On this circuit was a series of five Maxim arc lamps for which Wallace carbons were used costing ten cents each. Where the arc or incandescent wires ran beneath floors, the boards above were left loose so that they could be easily taken up to inspect the wires.

The plant was run on an average about five hours a day during which time it was necessary for the electrician to be continually on the watch to keep the apparatus in working order and after the plant had stopped running, considerable time was spent in overhauling the dynamos and wiring and in making needful repairs. On several occasions special illuminating effects were obtained with the incandescent lamps, of which the following is probably the most novel. At a banquet several glass globes with gold fish were placed upon the dining table. The globes were illuminated by incandescent lamps sunken in the water and a most striking effect was produced. Pieces of ice were put in the water from time to time to prevent it from becoming too hot for the fish. After being in operation for about two years, the plant was discarded and the dynamos consigned to the scrap heap. The building was then rewired and current for lighting obtained from a neighboring electric light station.

LITERATURE.

An Elementary Treatise on Theoretical Mechanics, by Alexander Ziwet. Part II. Introduction to Dynamics and Statics. New York. Macmillan & Co., 1893. 183 pages. 5½x9 in. Price $2 25.

In this work the author has sought to lay a foundation for the study of elementary kinetics and applied mechanics. The demonstration of methods is largely geometrical and graphical and the exercises throughout the work make it excellently adapted for text book purposes.

Theoretical Elements of Electro-Dynamic Machinery. By A. E. Kennelly, F. R. A. S. New York, D. Van Nostrand Co., 1893. Vol. I. 87 pages, 5½ x 9 inches. Price, $1.50.

IN the volume before us the author has collected in book form the series of articles which appeared a short while since in the columns of THE ELECTRICAL ENGINEER. In them the author has sought to place before the student of electrical engineering the applied arithmetical theory of electromagnetism as distinguished from the purely mathematical theory. He has succeeded admirably in stating in a definite and clear cut manner many points which are frequently obscure to the beginner. It is to be hoped that Mr. Kennelly will bring this work to its conclusion at an early date.

Note-Book of Wiring Tables. By Thos. G. Grier. Published by the author. Chicago, 1893. Pocket size, 64 pages.

Some five years ago it became the author's duty to calculate the sizes of wires for a number of his associates. To facilitate this work he compiled a number of wiring tables and collected others from well approved sources. These tables were grouped in a private note book which soon came into such demand that the compiler determined to publish it in printed form, so as to make it available to a larger number of workers. The present little volume is an expansion of the "Wiring for Motor Circuits" published by the same author two years ago, and contains tables constantly required by the electrical engineer, electric light superintendent and wireman on both lighting and motor circuits. The tables for motor circuits range from half an ampere up to 150 amperes, and from 50 to 1,200 volts, and also give the distance in feet that the different horse powers can be transmitted with one volt loss. In addition we find the regular incandescent lamp wiring tables for the standard 50, 110, 220 and 500 volt circuits. There are also tables for the primary wires of alternating circuits ranging from 1,000 to 5,000 volts. The tables are accompanied by examples showing the methods of employing them, which will greatly facilitate their use.

The Corliss Engine. By John T. Henthorn; and *Its Management*, by Chas. D. Thurber. Edited by Egbert P. Watson. Third edition, enlarged. New York, Spon & Chamberlain, 1894. 96 pages. 5x6 in. Price, $1.00.

This is an excellent little dissertation on the Corliss engine giving not only a description of the essential features of the engine itself but devoting special attention to each detail, such as the governor, valves and the method of setting them, lubrication, care of driving gears, etc., all discussed in a very clear and precise manner. In an appendix by Emil Herter the proportions of the engine are given, together with the principal dimensions and horse power of standard Corliss engines. This book ought to be in the hands of every engineer in charge of central station engines.

The Electric Transformation of Power and its Application by the Electric Motor including Electric Railway Construction. By Philip Atkinson. New York, D. Van Nostrand Co. Cloth. 12mo. 244 pages. 96 cuts. Price $2.

THIS is a book to be put into the hands of anyone who wishes to get an intelligent, comprehensive idea of what the modern electric motor is in principle and design, and what is being done with it in practice. Mr. Atkinson does not philosophize; he inflicts no formidable mathematics on the reader, but is a skillful compiler, wades industriously through a lot of matter and gives us the pith and purport of nearly all that people want to know. Where so many subjects are crowded into so small a space it is impossible to give all the details that everybody might like on every subject; but the man who reads Mr. Atkinson's book for general instruction will get it in rich and abundant measure. The book is well printed in large type on stout paper.

The Incandescent Lamp and its Manufacture. By Gilbert S. Ram, A. I. E. E. "The Electrician" Printing and Publishing Co., Ltd., London. Cloth. 8vo. 218 pages. 69 cuts. Price $3.

We could hardly name a more opportune book than this, appearing as it does at a time when both here and in England the incandescent lamp monopoly totters to its fall, and when the whole future of the art lies in the application of successful processes under vigilant management. Our London contemporary has done well and shrewdly in adding this to its excellent series at such a juncture. We do not believe for a moment that any book can lay bare all the secrets of the manufacture of good incandescent lamps. No book can, for no man would if he could. But there is a vast fund of information on every branch of the art given here, and the various chapters may be said to embrace all that is now a part of the common stock of data and experience, as distinguished from "trade secrets" and individual factory methods.

LEGAL NOTES.

GENERAL ELECTRIC COMPANY vs. CAPTAIN A. DE KHOTINSKY AND C. W. CARTWRIGHT.

THE case of the General Electric Company *vs.* Captain De Khotinsky for infringement of the Edison lamp patent, was heard on Tuesday, December 19th, in the United States Circuit Court, Boston, before Judge Colt. Messrs. F. P. Fish and D. K. Richardson, of Boston, represented the plaintiff and Mr. W. H. Coolidge acted for the defendants.

In opening the case, MR. FISH said the suit was brought against Capt. De Khotinsky for the manufacture of an infringing lamp in the factory of the Germania Electric Company at Marlborough, a company now under injunction by this court, and that Capt. DeKhotinsky had previously held the position of superintendent of the Germania factory; also against C. W. Cartwright for selling the above lamps, and that Mr. Cartwright had previously held the position of salesman with the Germania Company. Mr. Fish stated that the first lamps that were submitted to them were exact copies of the Edison lamp, but that the defendents now allege that they put a gas into their lamp, and were defending the suit in that ground. When Mr. Fish referred to the restraining order which Judge Colt had granted to the plaintiff, a few weeks ago, the judge created a little amusement when he remarked :—"Yes, I remember, I enjoined myself, from using my own lights," which is perfectly true, as it appears the Khotinsky lamps had been used in the Court Rooms for some months. Mr. Fish claimed that every Khotinsky lamp submitted in evidence, had a very high vacuum, though in the samples which had never been burned there was, on the testimony of experts, a slight trace of hydrocarbon gas. In the lamps which had been burned, this gas had altogether disappered, and the lamps really possessed a higher vacuum than the ordinary commercial Edison lamp. He then went on to explain to the court how the presence of gas in lamps could be determined, first by tapping the lamps, and watching

the vibrations of the filament in a gas lamp and in a vacuum lamp. In a gas lamp the vibrations would cease after a few seconds, while in a vacuum lamp they continued indefinitely. He showed the Court how in the Khotinsky lamps the vibrations of the filament, showed a very high vacuum, proving that the lamp infringed the Edison patent in this particular. The induction coil test was also explained, and showed a vacuum in the Khotinsky lamps by the evidence of the color of the resulting sparks or electric effect inside the glass chamber. Mr. Fish proved to the Court by the evidence of old patents of Maxim that putting gas in incandescent lamps was nothing new, but that the process had been abandoned as useless, when Edison perfected the present incandescent lamp. "Gases were never used" he said in conclusion, "since these old crude lamps, except for the purposes of litigation to evade the Edison patent," and he said they were only used "as a subterfuge, in this case a successful one."

MR. W. H. COOLIDGE then spoke for the defendants, and maintained that Capt. DeKhotinsky was not the Germania Company, nor a resuscitation of that company. He claimed that there was a difference between their lamps and the Edison lamp, the difference between "something" and "nothing." In the Edison lamp there is a vacuum,—"nothing;" in the Khotinsky lamp there was a gas,—"something," and he maintained that therefore the two lamps could not possibly be the same. Because DeKhotinsky would not disclose what was in the lamps, it was no proof there was nothing in the lamps. He said "We swear there is a gaseous vapor in our lamp and it is not placed there for a subterfuge, but to make a better lamp, a different lamp, and one that would last longer." He then submitted to the Court two small tubes, one containing a vacuum, the other the vapor which they used in their lamps. The eye could not detect the difference, yet there was a gas in one, as was proved when the two were heated, when it become clear to the eye that the one showed a totally different effect from the other. Decision reserved.

BRUSH ELECTRIC vs. BRUSH-SWAN.

IN the action brought by the Brush Electric Company against the Brush-Swan Electric Light Company, of New England, to recover $29,315.17 on merchandise delivered by the plaintiffs to the defendants, and for which the plaintiffs have been unable to recover, no response being made by the defendants, Judge Sedgwick of the New York Superior Court has ordered an inquest and found for the plaintiffs for $29,315.17, with interest since Jan. 1, 1888, amounting to $10,440.08, or $39,756.15, with costs of action added.

AN ATTACHMENT AGAINST THE FRENCH CABLE CO.

AN attachment for $19,865 has been obtained in this city against the Compagnie Française du Telegraphe de Paris à New York, in favor of Hector de Castro, for services in obtaining the declaration of the United States Government granting the right to that company to land its cable on the shores of Virginia. Deputy Sheriff Terry levied on the office furniture, safe, and telegraphic instruments at the company's office, 34 Broad street, and also on about $2,000 in the hands of a banker on Exchange place, belonging to the company.

THE DAVIS ELECTRICAL WORKS INJUNCTION.

IT will be remembered that an injunction has been granted against the Davis Electrical Works, of Boston, by Judge Colt, in that city, preventing them from "repairing" Edison lamps. The Davis Works have now carried the case to the Court of Appeals and express confidence in a reversal of the decision.

LETTERS TO THE EDITOR.

TELEPHONES IN NORWAY.

W. H. C. writes in the *Nation*, Vol. 57, No. 1479, page 326, on November 2nd, as follows:

"There are a few railways (in Norway) to be sure, but such a recent appliance as the telephone is used all over the country to an extent that is absolutely unknown in America, and the charge for it and the telegraph is astonishingly cheap."

It would be interesting to many of your readers if you would give a few comparative statistics on the use of telephones in the United States and the leading countries of Europe, as it seems strange that they should be so much further ahead than America in the use of the telephone, if the statements like the above are to be credited, and such statements have been seen in print quite frequently within the last year.

J. STANFORD BROWN.

NEW YORK CITY.

THE LATE ANTHONY RECKENZAUN.

WILL you allow me a space in the columns of your journal,—which has amongst its readers so many of my late husband's friends,—to thank them for sending me, in such numbers, letters of sympathy and condolence.

Their number is far too great for me to reply to them individually, and I hope you will give me this opportunity of expressing to them my warmest thanks, and the gratification it is to me to know how universally my husband was beloved and respected.

E. RECKENZAUN.

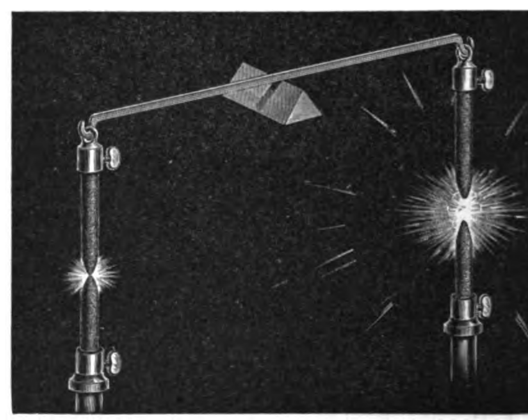
34 Hemberton Road, Stockwell, S. W., Nov. 27, 1893.

THE "SEE-SAWING" OF ARC LAMPS.

IN your issue of Dec. 20, I find a note on the "See-Sawing of Arc Lamps" which I am unable to understand. In all arc lamps with which I am acquainted, whether for regular series systems or for use on incandescent circuits, it is the office of the shunt coil to cause the carbons to approach when the voltage of the lamp increases. Instead of the increased voltage in the right-hand lamp of the figure in the note referred to "drawing the right-hand pair of carbons further apart," it should bring them nearer together and the diminished voltage in the left-hand lamp should permit the carbons to be drawn farther apart by the main current coil or the spring, or whatever separates the carbons.

If a pair of lamps on an incandescent circuit "see-saw" it must be due to other causes than that assigned in the note. Friction of the mechanism of the lamp, rendering it insensitive to small changes of voltage, is a fertile cause of such trouble.

In my experience with arc lamps run in pairs across an incandescent circuit I have not experienced this trouble of "see-sawing" but have found great trouble from fluctuations of current. Since an arc lamp requires 45 to 50 volts, a pair will require, say, 95 volts, leaving on a 110 volt circuit, over 15 volts to be taken care of by dead, that is, ever-varying resistance. Now since the total voltage *is* constant, no matter what the current, and about 85 per cent. of the resistance in the circuit is in the two arcs, it will be seen that it becomes a matter of very nice adjustment and extreme sensitiveness to maintain that arc resistance so nearly constant as not to cause great fluctuations in current.



"SEE-SAWING" OF ARC LAMPS.

To take an example: Suppose the lamps arranged for a normal current of 10 amperes. The dead resistance for a 110 volt circuit would be $1\frac{1}{2}$ ohms. If the current fall to 5 amperes the dead resistance consumes $7\frac{1}{2}$ volts, causing an increase on the two lamps of $7\frac{1}{2}$ volts or $3\frac{3}{4}$ volts each. If the current increase to 15 amperes the dead resistance consumes $22\frac{1}{2}$ volts, causing a fall of potential at the lamps of $7\frac{1}{2}$ volts, $3\frac{3}{4}$ volts each below the normal. If, therefore, the regulation of the lamp is effected by the shunt coil, it must be extremely sensitive, since such great variation of current either way from the normal can produce only such small variations in the voltage at the lamps.

Lamps to work in pairs across an incandescent circuit should regulate by both shunt and series magnets. The series magnets, in other words, should not merely draw apart the carbons and strike the arc, but should be so proportioned that the length of arc will be very sensitive to change of current; increasing in length when the current is a little too great and decreasing when the current is too small. The shunt coils should oppose the series coils, and they have no function except to maintain the equality of the two lamps. If the voltage at one lamp increases from the abnormal lengthening of its arc, the shunt in that lamp, by opposing more strongly the series coil, should shorten its arc.

The great difficulty in securing accurate regulation of arc lamps on incandescent circuits arises from the fact that an in-

crease of current by increasing the volume of the arc lowers its resistance and this, with the constant potential, causes a still greater increase. It is this that makes it necessary that every thing about the regulating mechanism be adjusted to extreme sensitiveness.

WM. A. ANTHONY.

MANCHESTER. Conn., Dec. 20, 1893.

SOCIETY AND CLUB NOTES.

N. E. L. A.

THE Ebbitt House has been selected as the headquarters for the Washington meeting of the National Electric Light Association. The session will be held in Grand Army Hall, Pennsylvania avenue, within one block from the hotel.

A NEW ORLEANS ELECTRIC CLUB.

AN electric club has been organized in New Orleans composed of practicing electricians of every class to whom the study of electricity is either a necessity or pleasure. Prof. Brown Ayres and Mr. H. J. Malochee have been elected president and secretary respectively. A committee on constitution and by-laws has been named as follows: Prof. Brown Ayres, Tulane University, chairman; Prof. B. V. Dixon, Tulane University; Mr. E. L. Bemiss, Edison Electric Light Company; Mr. G. A. Hopkins, New Orleans Traction Company, and Dr. W. O. Scheppergrell, Eye, Ear, Nose and Throat Hospital.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the monthly meeting of Council, held December 20, the following associate members were elected: E. L. Etheridge, Inspector, Electrical Engineering Dept., World's Columbian Exposition, 66 N. Oxford street, Brooklyn, N. Y.; Chas. T. Lindner, Inspector, Electrical Engineering Dept., World's Columbian Exposition, Tacoma, Washington; Frank A. Williams, Safety Insulated Wire and Cable Co., 25 Washington avenue, Newark, N. J.; D. McFarlan Moore, Electrical Engineer, General Electric Co., 44 Broad street, New York City; Arthur Newhall Mansfield, Assistant Electrician, American Telephone and Teleg. Co., 153 Cedar street, New York City; Charles L. Sturtevant, Patent Attorney, Atlantic Building, Washington, D. C.; Wm. L. Puffer, Assistant Professor of Electrical Engineering, Mass. Institute of Technology, Boston, Mass.; Louis K. Comstock, Contracting and Consulting Engineer, Monadnock Building, Chicago, Ill.; Herbert S. Mustin, Assistant Electrician, City of Hoboken, Police Headquarters, Hoboken, N. J.; Chas. H. Warner, Consulting Electrical Engineer, 50 Broadway, New York City; W. A. McClurg, Manager, Electrical Dept., Plainfield Gas and Electric Light Co., 25 Madison avenue, Plainfield, N. J.; Oliver R. Roberson, Electrician, Western Union Telegraph Co., 195 Broadway, P. O. Box 856, New York City; Leonard C. Wason, Head Draughtsman with F. S. Pearson, 199 Harvard street, Brookline, Mass.; Dr. Johann Sahulka, Docent of Electrotechnics, Technische Hochschule, Vienna, Austria; W. Le Conte Stevens, Professor of Physics, Rensselaer Polytechnic Institute, Troy, N. Y.; Daniel W. Shea, Assistant Professor of Electrical Engineering and Physics, University of Ill., Champaign, Ill.; C. R. McKay, Consulting Engineer, 140 South Main street, Salt Lake City, Utah; Mario Capuccio, Electrical Engineer, Piazza Statuto 15, Torino, Italy; John E. Hudson, President, The American Bell Telephone Co., 125 Milk street, Boston, Mass.; Henry Judson Sage, Electrical Engineer, Telephone Dept., Western Electric Co., 227 S. Clinton street, Chicago, Ill.; Francis R. Frost, Assistant in Electrical Testing, Bureau of Awards, World's Fair, Ithaca, N. Y.; A. A. Serva, Assistant, Bureau of Awards, World's Fair, North Industry, Ohio; A. Marcel Requier, Electrical Engineer, Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.; Charles L. Jaeger, Inventor, Maywood, N. J.; James W. McCrosky, Graduate Student, Johns Hopkins University, 1104 McCulloh street, Baltimore, Md.; Fred. B. Corey, Electrical Engineer, A. B. See Manufacturing Co., 442 Henry street, Brooklyn, N. Y.; Elbert F. Norton, Inspector, City Electrical Inspection, 15 City Hall, Chicago, Ill. Total 27.

PERSONAL.

HON. GARDINER C. SIMS, of the Armington & Sims Engine Company, Providence, R. I., has, we are sorry to report, been seriously ill with an attack of grip. We are glad to learn of his convalescence, and trust he will soon be able to resume daily duties.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 12, 1893

Alarms and Signals:—

Electric Call System, S. Whitehall, South Bend, and E. W. Whitehall, Attica, Ind., 510,457. Filed March 7, 1893.

Plate for Mounting Bell Pushes, J. F. Wollensak, Chicago, Ill., 510,663. Filed Nov. 22, 1892.

Conductors, Conduits and Insulators:—

Insulator Pin, F. M. Locke, Victor, N. Y., 510,809. Filed Apl. 5, 1893.

Distribution:—

System of Electric Distribution, E. W. Rice, Jr., Swampscott, Mass., 510,487. Filed July 10, 1893.

Employs feeders connected to generators of different potential and means for keeping the circuits independent of one another or interconnecting them at will so that all the generators will simultaneously feed a single circuit.

Electric Current Transformer, W. H. Hornberger, Elkhart, Ind., 510,640. Filed March 31, 1893.

Relates especially to the mechanical construction of the transformer and the cheapening of its manufacture.

Automatic Circuit Controller, C. L. Mayhew, Saratoga Springs, N. Y., 510,646. Filed May 26, 1893.

Employs a spark coil, a cut-out device included in the circuit and a high resistance in a shunt around the cut-out device.

Dynamos and Motors:—

Dynamo Electric Machine, D. H. Wilson, Chicago, Ill., 510,460. Filed Dec. 27, 1892.

Employs wedged-shaped armature sections composed of a series of wedged-shaped plates held in position by rods.

Regulator for Dynamo Electric Machines, L. Bell, Boston, Mass, 510,465. Filed April 3, 1893.

Employs a rotary transformer coupled in circuit and driven by alternating or multiphase currents from the main machine, and supplying a rectified current which excites the field of the main machine.

Electric Fan, E. H. Bennett, Jr., Bayonne, N. J., 510,466. Filed Oct. 17, 1891.

Claim 1 follows:—

A suspended electric fan provided with a resistance for varying its speed, and the fan or fan support being provided with a switching device placed below the blades of the fan.

Dynamo Electric Machine, R. Eickemeyer, Yonkers, N. Y., 510,472. Filed May, 28, 1889.

Employs a core foundation for the armature having a spiral groove containing iron wire, and additional layers of iron wire each of which serves as a spiral foundation for the next overlying layer; each convolution being insulated from the others.

Dental Engine, L. S. Pfouts, Canton, O., 510,484. Filed Jan. 13, 1893.

Rotary Current Motor, J. H. F. Goerges, Berlin, Germany, 510,534. Filed April 30, 1891.

A motor so arranged that both the fixed and the rotating parts are in circuit with the source of energy and so connected that the fields shall be approximately of equal strength and will rotate in the same direction, whereby the motor may be readily started from a condition of rest.

Alternating Current Motor, W. Hochhausen, Brooklyn, N. Y., 510,601. Filed Sept. 4, 1891.

Employs an armature having in relation to the alternations of the applied electromotive force an increased lag, and a field magnet having a decreased lag.

Regulating Parallel Circuited Alternate Current Machines, C. Hoffmann, Berlin, Germany, 510,862. Filed Sept. 28, 1893.

Consists in bringing the several machines independently to a determined speed from a common point through the regulation of the governors of their respective energizing apparatus, and subsequently switching them into circuit.

Galvanic and Thermo-Electric Batteries:—

Electric Battery, L. F. Johnson, Poughkeepsie, N. Y., 510,605. Filed July 11, 1893.

Has for its object to prolong the time during which a current of constant strength may be obtained from a cell.

Lamps and Appurtenances:—

Electric Arc Lamp, J. F. Kester, La Grange, Ill., 510,606. Filed Apl. 24, 1893.

Relates especially to mechanism for automatically cutting the lamp out of circuit when the feed mechanism fails to operate or the carbons are burned out.

Metal Working:—

Apparatus for Heating Metal Electrically, C. L. Coffin, Detroit, Mich., 510,-777. Filed July 8, 1893.

Employs an annular conductor and a stationary magnet for causing the arc to rotate about the place to be welded.

Miscellaneous:—

Range Indicator, B. A. Fiske, United States Navy, 510,417. Filed Mch. 3, 1893.

Dynamo Electric Regulator for an Engine driving a Generator, R. M. Hunter, Philadelphia, Pa., 510,602. Filed Oct. 29, 1892.

Applies especially to governing mechanism for railway central stations.

Power Applying Device for Electric Motors, A. H. Johnson, Rahway, N. J., 510,603. Filed Dec. 15, 1892.

Relates to the operation of railway semaphores, gates, switches, etc.

Magneto Electric Induction Apparatus, C. J. Reed, Orange, N. J., 510,613. Filed September 10, 1892.

Claim 2 follows:

A series of converters consisting each of a pair of insulated primary and secondary conductors located side by side and connected to a common return circuit.

Process of and Apparatus for Dissociating Soluble Salts by Electrolysis, H. S. Blackmore, Mount Vernon, N. Y., 510,834. Filed March 16, 1893.

Lightning Rod Ornament, J. J. Cole, St. Louis, Mo, 510,837. Filed July 29, 1890.

Railways and Appliances:—

Trolley Wire Support, L. S. Pfouts, Canton, O., 510,485. Filed July 19, 1893.

The invention relates especially to the means of suspending the hanger from the bell and clamping the wire.

Electric Railway Conduit, W. R. De Voe, Shreveport, Pa., 510,634. Filed July 20, 1893.
Employs a longitudinal gas pipe within the conduit having jets at intervals to keep the conduit warm and free from moisture.
Conduit Electric Railway, J. P. Michieli, San Francisco, Cal., 510,647. Filed July 14, 1893.
Relates especially to means for protecting the contacts from moisture.
Electric Car Truck, C. F. Winkler, Troy, N. Y., 510,661. Filed Nov. 26, 1892.
The invention consists in having two rotary armatures in a single magnetic circuit, in combination with two car axles to which the armatures are respectively geared.
Electric Motor, C. F. Winkler, Troy, N. Y., 510,662. Filed Dec. 24, 1892.
Employs a ring magnet and rotary armature in combination with a traveling switching apparatus arranged to send current through the magnet coils and establish rotating consequent poles in the ring.
Closed Conduit System for Electric Railways, R. H. Elliott, Birmingham, Alabama, 510,850. Filed July 5, 1893
Employs a system of sectional conductors brought into connection by the car in passing.

Switches and Cut-Outs :—

Electric Switch, J. S. Gibbs, Hartford, Conn., 510,533. Filed March 15, 1893.
A quick break snap switch for incandescent lights.
Push Button, R. M. Hunter, Philadelphia, Pa., 510,540. Filed April 3, 1891.
Reversing Switch for Electric Motors, J. G. Germann, Erie, Pa., 510,596. Filed April 19, 1893.
Provides means for making a quick break of the circuit without turning the switch shaft quickly.
Electric Snap Switch, G. W. Hart, Windsor, Conn. (Reissue), 11,395. Filed Sept. 15, 1891.

Telegraphs :—

Telegraph or Telephone System, W. R. Kirk, Kansas City, Mo., 510,430. Filed Nov. 3, 1892.
A secret system in which the message travels over changing conductors at intervals so that any intercepted communication will be unintelligible.
Simultaneous Telegraphy and Telephony, S. W. Holman, Boston, Mass., 510,506. Filed May 31, 1893.
Has for its object to connect telephone apparatus to the telegraph line so that the current in the latter shall produce at all times equal potentials at both terminals of the telephone and thus neutralize one another.
System of Telegraphy, C. J. Reed, Orange, N. J., 510,612. Filed April 12, 1892.
The system consists in setting up two sets of secondary impulses, one at each station, and combining their effects with local direct current effects at the station.

Telephones and Apparatus :—

Telephone Exchange System, W. W. Jacques, Newton, Mass., 510,863. Filed Dec. 1, 1892.
By this system the apparatus by which the subscribers signal to the central office is eliminated and a large number of subscribers' telephones are put normally in circuit with a single operator's telephone, each by a separate metallic circuit.

NEW YORK BOARD OF FIRE UNDERWRITERS.

At the last meeting of the New York Board of Fire Underwriters the superintendent recommended the following resolution, which was adopted :

"Resolved, That hereafter this Board decline to issue approval for electric equipments for advertisement purposes in show windows and mercantile establishments, where motors are used or where electric currents are shunted or broken on different currents for display purposes."

A number of merchants have been in the habit of making electric advertising displays in their windows. The work is for temporary purposes, and is said to be generally not of that substantial character called for by the rules of the Board, and if it were substantial and permanent, underwriters claim that it is not for regular lighting and is unnecessary in their business. The underwriters intend to permit the use of electricity only for pure lighting and hoisting purposes.

Under the rules of the New York Board of Fire Underwriters, where electricity is used for manufacturing purposes such use makes the risk a special hazard, and insurance men feel where motive power or breaking of currents exists the same risks prevail as in the use of electricity in manufacturing.

ELECTRICITY ON BRAZIL'S WAR SHIPS.

The Brazilian cruiser *Nictheroy* is fitted with a complete electrical equipment The plant consists of two 10 x 10 inch 50 h. p. Ideal engines, each belted to a standard General Electric compound wound bipolar dynamo of thirty kilowatts or 540 sixteen candle-power lamps capacity each. Upon a slate switchboard near the dynamos are mounted a full complement of marine volt- and ammeters, and a double pole knife switch for each circuit leaving the board. There are five circuits for the 300 incandescent lamps installed, two for the search lights and one for the fifty horse-power motor. The switchboard is so arranged that either dynamo can be used either on the motor or lighting circuits. The wires from the board are led through a special moulding, and wherever exposed to moisture are provided with a leaden armor. All the appliances such as switches, receptacles, etc., are of the same watertight pattern as used on the United States war vessels, as are also the fixtures, portable lights, deck and battle lanterns. For the last a separate circuit has been provided. They can thus be carried from place to place, and connected at different convenient points.

On the roof of the pilot-house is set the automatic thirty inch search light, similar in size and intensity to that on Mt. Washington which throws a beam of light which can be seen from Portland, Me., 85 miles away. That on the *Nictheroy* is flanked on both sides by Hotchkiss rapid-firing machine guns and can project a beam of light from its spherical concave mirror sufficiently powerful to allow light-colored objects to be easily distinguished at 6,000 yards. It is furnished with a diverging lens, by which the beam can be diverged horizontally to cover a wide space. The lamp takes a current of 100 amperes to produce an effective arc between the points of the two one and a quarter inch carbons. In the pilot-house is a small switchboard from which the search light is electrically controlled and may be moved in any direction horizontally or vertically. The small motors which do this work are concealed in the iron pedestal of the projector. The after search light is used as an auxiliary. It is of the same pattern, but has a mirror of only 12 inches, and is hand controlled.

The "Britannia" is also fitted with one twenty-four inch and one twelve inch projector. A fifty horse power motor is used to train the dynamite gun, which can be raised, lowered, or turned to left or right as required. A system of electric signals completes the electrical equipment. The work was done by the New York department of the General Electric Company.

CHRISTMAS PRESENTS.

Alfred F. Moore, the Philadelphia manufacturer of insulated wires and cables has mailed to his customers a calender for 1894. The reading matter is handsomely embossed while the figures in which the dates are printed are so large as to make the calendar serviceable at long range.

The Pope Manufacturing Co., following their usual custom, have issued for 1894 a "Columbian" desk calendar and memorandum pad. Of course the user is confronted each day with the opinions of many men in regard to the advantages to be derived from bicycling, and there have been added to these a few pen and ink sketches—one for each month—illustrating the use of a bicycle under the various weather conditions.

The Joseph Dixon Crucible Co., of Jersey City, have been sending out a sample or two of their pencils for editor's use ; the leads are smooth and tough, making the work of the weary editor a pleasure.

MR. W. P. MASHINTER.

Mr. W. P. Mashinter, of Montreal, has resigned his position of electrician and superintendent of the Citizens Light and Power Company and commenced business on his own account as electrical engineer and contractor, with an office in the Temple Building. Mr. Mashinter has considerable experience in electrical matters and starts business with very good prospects, having secured the local construction work of one of the largest electrical companies and the appointment of supervising engineer of the Temple Electric Company.

"ELECTRICAL LITERATURE."

Prof. Wilbur M. Stine, director of the department of electricity of the Armour Institute, Chicago, in addition to his other duties, will have editorial charge of the monthly magazine *Electrical Engineering*, and of the valuable monthly summary of current technical literature, which heretofore has borne the title of De Land's Synoptical Index, but hereafter to be published under a separate cover bearing the title of *Electrical Literature*. Mr. Fred. De Land will retain the business management of both publications.

LIGHTING THE NATIONAL CAPITOL.

The sum of $200,000 is to be spent in supplying the Capitol at Washington with an electric light plant. From the same central station it is also proposed to light the new Congressional Library and the adjoining grounds.

ELECTRIC LIGHTING IN COREA.

The Corean government has purchased an electric lighting plant for the use of his majesty the king of the Hermit Nation. The king's palace will be lighted by incandescent lamps of 16-candle power.

PHILADELPHIA NOTES.

After January 1, Messrs. J. W. Parker & Co., 41 North Seventh street, Philadelphia, Pa., who have ably represented the Ball Engine Company, of Erie, Pa., in that city for years, will also act as their representatives in the city of New York for the sale of "Ball" engines.

The Dale Mfg. Co., of No. 22 Courtlandt street, are wiring the new building of Mayor, Lane & Co. on White street. The Dale Company has just issued a catalogue of electric light fixtures which they manufacture.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE WALKER MFG. CO. OF CLEVELAND IN THE ELECTRICAL FIELD.

As announced in The Electrical Engineer last week, the Walker Manufacturing Company of Cleveland, O., which has been actively engaged in the manufacture of cable railway machinery, is now making the necessary additions to its plant for the manufacture of the latest and most powerful types of generators and motors for electric railway and power transmission purposes ever constructed, not only in the United States, but in foreign countries.

This new departure of the Walker Manufacturing Company, while it will in no degree affect the output of their other specialties is far more significant than would appear at first glance. The company, in the production of its powerful cable machinery, including the world-famed Walker differential drums, the largest designs of hydraulic machinery, traveling cranes, also mining and foundry plants, is easily foremost among corporations or firms of its kind in this country. Its reputation for heavy machinery is, in fact, international. The entrance of such a company in the electrical field, fully equipped, and moreover sustained by a world-wide reputation, must have a marked influence.

One of the serious drawbacks encountered in the manufacture by existing companies of generators of great capacity has been a lack of facilities for handling large work. The Walker Manufacturing Company's facilities are such as to place them at a decided advantage, when it is known that they have produced some of the largest work ever made in this country. They have cast safely and with ease, a forty-two ton casting, and have capacity to make a sixty ton casting if needed. From this some idea may be gained of its possibilities of handling the largest generators that may be required.

As has been previously stated, the Walker Manufacturing Company's plant is most admirably adapted for the manufacture of high-class electrical machinery. From the completion of the enlarged portion of the works in the spring of 1891, dates practically the great constructive facilities. The plant with its subsequent additions now occupies fully thirteen acres of ground. The location of the works in Cleveland is unsurpassed; that city possessing great natural advantages for manufacturing. The buildings are of brick, fronting on Waverly avenue, and occupy a commanding view of Lake Erie. The machine shop, which is said to be the finest in the United States, is 171 feet wide, divided into three bays, each 57 feet wide. In length, two of the bays are 280 feet, and the third 430 feet. From the floor to the highest part of the roof is 54 feet; massive wrought iron pillars support the traveling crane girders and the roof, which is of iron and glass, thus affording plenty of light. In each bay is a 30 ton rope power traveling crane manufactured by the Walker Manufacturing Company for their heavy work. On all sides, one sees a bewildering array of machinery. In Bay A, most of the fitting and erecting is done. A line of vices arranged on a continuous bench 280 feet long is rather an unusual sight; in this bay are arranged all the drill presses and similar tools used in fitting and finishing work. Large pits walled and paved with brick are arranged for erecting work in them that would otherwise be inconvenient to get at. A 30 ton crane travels the entire length of this bay.

In Bay B, are arranged all the large lathes, planers and floor boring machines. A 10 x 10 x 25 foot open side planer using four tools if necessary, is a formidable machine. The floor boring and milling machine has a capacity of 14 foot horizontal and a 6 foot vertical lift and a 6 foot feed horizontally. The floor bed outside of the machine proper is 20 x 20 foot. Numerous lathes, planers and shapers are found in this bay. A 30 ton crane travels the entire length of this bay also.

In Bay C, are boring mills of the following sizes: 7 foot, 10 foot, 14 foot, 16 foot and 16 to 24 foot capacity. Horizontal boring and other machines, also a 10 foot Gleason gear planer capable of cutting spur or bevel gears 30 inch face. The immense pit lathe with all the large gears, belt and rope pulleys have been turned in in this bay. The large girders of the lathe are 90 feet long. All the driving gears of this powerful tool are of cast steel. Two 32 foot diameter by 8 foot 6 inch rope pulleys, each 104 tons, have been turned in this lathe at one time. A depressed railroad track from the L. S. & M. S. R. R. runs across this bay so that cars and locomotives can run into the shop. The immense platform scales are also arranged in this point for weighing shipments. Work is transferred from machines and scales, to or from railroad cars, with another 30 ton crane which travels the entire length of the bay, 430 feet.

The machine shop is fitted with galleries for special purposes. Under one are arranged all the small lathes. Under another gallery is the tool room fitted with all modern appliances. On one of these extensive galleries is located all bolt and nut cutting machinery also. All bolts and nuts are carefully kept in stock. An immense storeroom is located at the east end of Bay B, and convenient to the office.

Although it may be an old story by this time, the capacity of the works for turning out spur gearing is worthy of repetition. A machine cut spur gear of 192 teeth, claims the distinction of being the giant wheel of its kind ever placed in use, as will be seen by the following dimensions: 30.66 feet pitch diameter; 30 inch face; 6 inch pitch; 27 inch bore; diameter of hub 9 feet 2 inches; weight of hub 15 tons; weight of gear 66.75 tons. This wheel was shipped by the Walker Company to the diamond mines of South America. It may be mentioned in this connection that pulleys and cable drums have been shipped to England and Australia.

The foundry of the company is 300 feet long, 118 feet wide and is built in three bays. The centre bay is 57 feet in width and 41 feet in height to the tie beams. It has truly been said to be the model foundry of the country. Here also, everything is on a gigantic scale. To move the ponderous castings, two 30 ton rope power traveling cranes are utilized in the central bay, while the side bays are provided with two each twelve ton cranes operated by separate engines. Another foundry, 58 feet by 200, adjoining is used for smaller castings. Absence of smoke and good ventilation is an important feature of the large foundry. The metal for both foundries is supplied from four Walker improved cupolas of following dimensions: Two, 60 inches in diameter; one, 72 inches in diameter; one, 84 inches in diameter, affording a capacity of 80 tons of metal per hour.

The cupolas are built upon a scientific plan of economy and melt an average of 13.10 lbs. of iron per pound of coke. The air is supplied from a three cylinder vertical blowing engine. Hydraulic power is used for breaking metal and elevating all the necessary coke, iron and limestone. The elevator will raise a load of six tons, the power being developed in a 14 inch accumulator of 14 feet stroke, with an average pressure of 1,000 lbs. to the square inch.

The core ovens are 24 by 30 feet, 20 by 30 feet, and 18 by 25 feet, respectively. They are, of course, of the latest design, and it is almost unnecessary to add that gearing and crank handles serve to operate the carriages.

Large casting pits are located at various parts of the foundry floor, ranging from 24 to 12 feet in diameter, and reaching a depth of 25 feet. The capacities of the crane ladles vary from 3 to 25 tons.

Inasmuch as a good share of the work done in constructing electrical machinery consists in castings, the foregoing descripton of its foundry will indicate the superior facilities of the Walker Manufacturing Company in its new department. In existing companies, it is rather the rule than the exception to purchase a portion of the castings for each machine, of outside foundries. In the present case, however, greater uniformity in its castings is secured, by doing the entire work within the plant, than could be obtained from various foundries managed with different degrees of skill.

The type of motor to be offered by the Walker Manufacturing Company, will, it is believed, elicit marked commendation and will also be a distinct advance on existing machines. In the past there has been a somewhat general feeling that the weight of the apparatus has been greater than either strength or electrical efficiency demanded. This imperfection results very largely from an improper distribution of the metal. With the new generators and motor of the Walker Manufacturing Company, particular care has been used in designing the castings, so that the maximum of strength and electrical efficiency, with the minimum of weight may be obtained. It is confidently believed, that as regards these three important features—lightness, efficiency and strength,—the Walker Manufacturing Company's motor will be appreciated by those interested in electric power and traction.

Mr. H. McL. Harding, of New York, and Mr. J. L. Barclay, of Chicago, are interested with the Walker Manufacturing Company in this department. Their continuous connection with the business of selling and manufacturing electric railway appliances from the very inception of the industry renders them well fitted for what they have undertaken. Having been connected with the Sprague Company in 1887 and afterwards with the Westinghouse Company, their exceptional and rare experience has enabled them to know thoroughly the weak spots of existing machinery, and to offer the best that the advance of the art can afford.

Mr. John Walker, the founder, vice president and general manager of the company, has had an exceptional and uniformly successful experience as a practical mechanical engineer. He is a native of England, but has been a resident in this country for twenty-five years. Mr. Walker has taken out 62 patents for valuable machinery and mechanical devices, but his fame may be said to have been made by his invention of differential drums for cable roads.

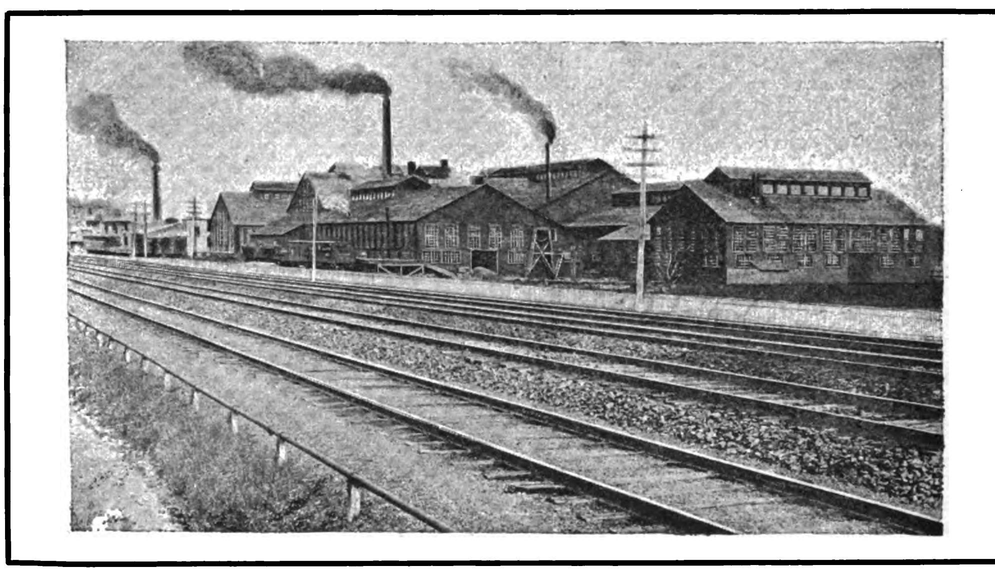
Mr. J. B. Perkins, president of the company, is one of the best known business men in Cleveland and elsewhere. His great wealth has made him a prominent factor in financial circles, while his executive abilities have long been recognized in the many enterprises with which his name has been associated. Mr.

W. H. Bone and Z. M. Hubbell, respectively manager and treasurer of the company, have occupied their present positions for several years.

In the electrical power and traction department, Mr. Harding will be in charge of the Eastern business, with headquarters in New York. Mr. Barclay will have the management of Western business, located in Chicago.

THE NEW FACTORY OF THE C. & C. ELECTRIC CO. AT GARWOOD, N. J.

The C. & C. Electric Co., of 402–4 Greenwich street, this city has recently issued notice that they will continue under that designation the business built up and thus far carried on by the C. & C. Electric Motor Co. They have also taken a most important step in arranging for the removal of their factory to Garwood, N. J., on the line of the New Jersey Central, where they have acquired a fine mill property. We give a view of the factory, which hardly does justice, however, to the plant, as it does not bring out well the main building away from the railroad. That building is 500 feet long, with wings 200 feet long, and which is being fitted up with a C. & C. electric crane, of 10 tons, to travel 320 feet. All told, the factory affords about 100,000 square feet of floor space. The buildings are of iron and steel construction. With these new and larger facilities, the company will develop their line of heavier apparatus for light as well as power, and endeavor to enhance the reputation already won by C. & C. apparatus in the smaller sizes of dynamos and motors. They will build machines up to 100 k. w., and larger where required. The company now have several important orders in hand, and are looking forward to the removal early next year, as it will enable them to undertake much work that awaits them.



The C. & C. Factory at Garwood, N. J.

LACONIA CAR CO.

The Laconia Car Co., Laconia, N. H., the largest builders of steam railroad equipments in New England, are now building street railway cars, of all kinds, electric, cable, and horse. The reputation of this company as builders of the highest grade of cars is sufficient proof that their street railway cars will be of the very best workmanship. Their facilities are unsurpassed for turning out cars at low prices, and giving prompt and reliable deliveries. The company employ between six and seven hundred skilled workmen. Their Street Railway Dept., will be in the charge of Mr. F. E. Huntress, 8 Oliver St., Boston, Mass. The Laconia Car Co., will build according to specifications, or will duplicate any car now in use, and their prices will probably be such as will commend themselves to economical and careful railroad officers.

THE WESTINGHOUSE WORLD'S FAIR PLANT SOLD.

The Westinghouse Electric and Manufacturing Company have, it is reported, made contracts for the sale of 15 of the 1,000 horse power dynamos and engines at the World's Fair, thus disposing of the entire plant for the illumination of the Fair, and three additional outfits of the same size. The sale will, it is said, bring to the company nearly $750,000 to which should be added the sum already received for the use of the apparatus for the lighting of the Fair.

THE ADAMS ELECTRIC CO.

Mr. A. D. Adams has resigned his position as electrician and manager of the Commercial Electric Company, and has formed with others the Adams Electric Company, for the manufacture of his improved dynamos and motors, at Worcester, Mass.

Mr. Adams' new machines will be of the same general type as his former ones, will embody his well-known forged iron field magnet construction, and several important improvements. Realizing that most armature burn-outs are due to the destructive action of heat cn the cloth and paper usually employed to insulate armature cores from their windings, Mr. Adams will use a fire-proof material for the insulation of all armature cores in his new machines. The line of dynamos and motors at present manufactured, will cover the usual sizes, from 1 to 25 k. w.

A large well-lighted shop is being fitted up at 100 Beacon St., Worcester, for the manufacture of the above machines, and shipments of any of the sizes named can be made during January next.

The encouraging fact is reported that orders for several machines have already been received.

PEPPER & REGISTER.

The above engineering firm of Provident Building, Philadelphia, have the contract for the overhead construction work of the Philadelphia Traction Co., which amounts to over 130 miles; and they have just closed the contract for the work of the Electric Traction Co. of the same city, whose line is about 124 miles in length. This work will extend over two years. The same firm have also a contract for the building of an electric road in Lynchburg, Va., including the laying of tracks, paving streets, and overhead construction.

Pepper & Register have taken the agency for the automatic engines of J. H. McEwen Mfg. Co., of Ridgway, Pa., and are now pushing the sale of the engine in their vicinity.

The firm say that they regard the 1894 outlook as very favorable in the street railway line, as idle capital in Philadelphia is seeking investment while labor and material are cheap.

NEW YORK NOTES.

The Elson & Brewster Engineering Co., formerly of 123 Liberty street, have removed to 141 Liberty street on the ground floor of the Central Building.

The Electrical and Mechanical Engineering and Trading Co. of 44 Broad street, inform us that Mr. U. T. Fackenthall will no longer be connected with them.

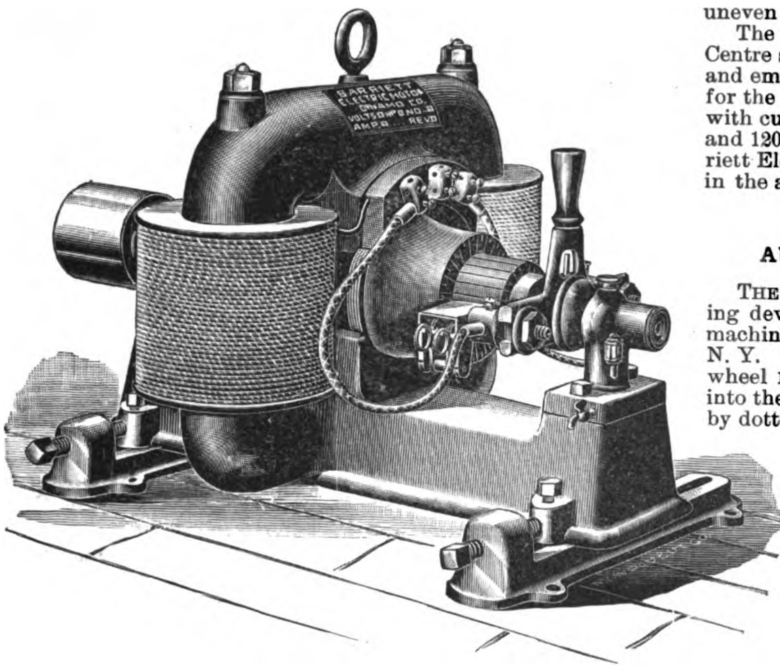
The Clayton Air Compressor Works, 43 Dey street, New York, have issued a very interesting pamphlet on "The Widening Use of Compressed Air." It is in fact a reprint of an article by Mr. W. P. Pressinger in the *Engineering Magazine*. Reference is made to a great variety of plans and projects.

PHILADELPHIA NOTES.

The Phosphor Bronze Smelting Company, Limited, have removed to new offices at 2,200 Washington avenue, Philadelphia, where they have built a new foundry and smelting works and greatly increased their facilities.

THE ELECTRIC SEAL-UNHAIRING MACHINE.

Probably few of the many ladies who are the proud possessors of seal skin garments are aware that electricity has been brought into play in preparing the glossy skin for wear. As in the case



Barriett Low Potential Dynamo.

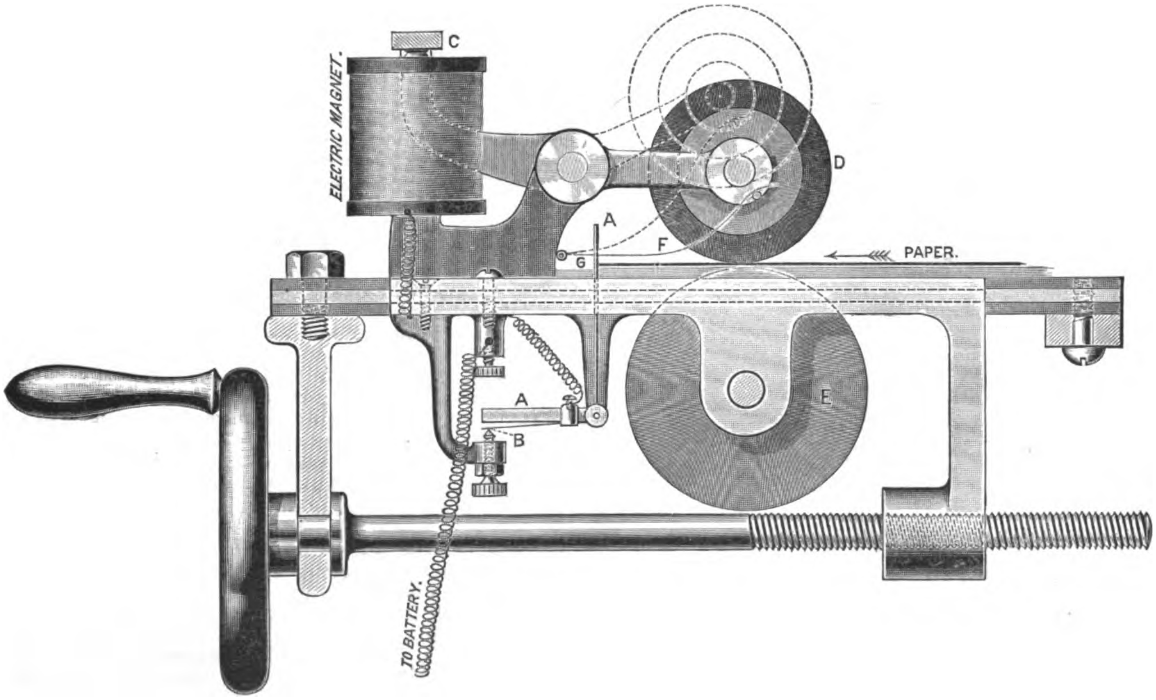
of the beaver, the seal skin, as it comes from the animal has interspersed with the soft downy hairs a certain proportion of long stiff hairs, which must be removed. Heretofore this has been done by hand, but recently, Mr. Headbalmany, of this city has devised an unhairing machine which has greatly reduced the time and labor required as compared with the old hand method.

The machine resembles somewhat a cotton gin and like the latter, has a rotary brush; but in the place of the saw used in a gin, a No. 20 platinum wire 20 inches long is employed. This wire is kept red hot by an electric current supplied from a 20 volt dynamo, the resistance of the hot wire being 1 ohm and the current 20 amperes. The sealskin runs through rollers up to a flat steel plate where the skin turns sharply over the edge of the plate. In doing so, the long stiff hairs project up, and when the machine is put in action the hot platinum wire which is kept tightly stretched comes down low enough to burn the stiff hairs off. The skin then feeds $\frac{2}{1000}$ of an inch before the hot wire comes down again. As it passes the rotary brushes the burned hairs are brushed off, and the fur comes out perfectly free from stiff and uneven hairs.

The North American Electric Seal-Unhairing Co., of No. 241 Centre st., this city, are operating 60 of these unhairing machines and employ fully 100 girls sewing seal skins and preparing them for the machines. The unhairing machines are being supplied with current by a Barriett generator with a capacity of 20 volts and 1200 amperes; this generator was manufactured by the Barriett Electric Motor & Dynamo Co., of this city and is illustrated in the accompanying cut.

AUTOMATIC ELECTRIC SHEET REGISTER.

The accompanying illustration shows a new electric registering device to be used in connection with marginal bookfolding machines, made by the Dexter Folder Company, of Fulton, N. Y. The lower wheel E has a continuous motion, and the upper wheel D is operated as a friction drop roller. As the sheet comes into the folder, the drop roller D is elevated to the position shown by dotted lines; but as soon as the sheet reaches the first fold gauge, this roller is brought in contact with the lower roller, and the sheet being between the two, is carried endwise until its advancing edge comes in contact with the circuit-making lever marked A A and tips its upper end sufficiently to cause the lower end to touch the connecting point B, thus completing the electric circuit that lifts the friction roller D by its lever C being drawn down upon the electro-magnet. This action is instantaneous, and entirely automatic. The electric connection cannot be made except by the advancing edge of the sheet and there can be no variation in the point reached by the edge of the sheet each time. The movement of the lever A A is so sensitive that it can be operated by a sheet of tissue paper. It is perfectly balanced and the lightest pressure will bring its lower end into electric contact. The space of G is slightly exaggerated in order to give room to illustrate the principle of construction. The space at this point is just sufficient to allow the sheet to move freely with no possibility of its edge curling up, and even should the edge be curled before the sheet reaches this point, the fender F would press it out flat before it reaches the electric lever, causing all sheets to lie exactly alike. The complete attachment slides in grooves, the side register being made by simply turning the hand wheel without stopping the machine. The electric attachment takes hold of the sheet at the same point that it was fed to in printing. The forms are so placed on the press that the gripper edge of the sheet comes in contact with the first fold gauge on the folding machine, so that the sheet before it



Automatic Electric Sheet Register.

is started into the first fold rollers, is automatically registered to the same end and side used in printing, and is adjusted to the gauges with more accuracy than would be possible were they placed there by hand. To furnish the electric current, sal ammoniac batteries are used. Four cells give an abundance of current, while two will operate the attachment perfectly.

THE CROWN GLASS OIL CUP.

The accompanying illustration represents Lunkenheimer's "Crown" index sight-feed glass oil cup for dynamos and general engine bearings, made by the Lunkenheimer Company, of Cincinnati, O.

The cup is provided with an index device for regulating the flow of oil, and an indicator arm turning on the lid to mark the notch giving the proper feed. When desired, the feed can be instantly turned off and on again, by replacing the index lever in the notch of the indicator arm. When the index arm is closed the lever can be left to stand up out of the notch, thus acting as an indicator to show from a distance that the feed is shut off.

It is often the case where a number of cups require different feeds, especially before starting the engine, that an extra amount

The Crown Glass Oil Cup.

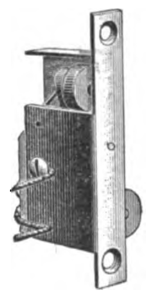
of oil is wanted. This can easily be accomplished with the "Crown" without losing the original feed, by simply moving the indicator arm a few notches to the right, and when the established feed is again required it is only necessary to replace the arm in the index slide, which marks the established feed.

These cups are all made of cast brass, handsomely finished, and are heavy and durable. The oil will not leak out between the brass and the glass parts, as sometimes occurs with spun brass cups.

Wherever these cups have been put in use, it is said, they are giving the very best of satisfaction. They are made in eight sizes holding from ⅝ to 18 ounces of oil.

Besides the "Crown," this company make seven other styles for various purposes, all of which are fully described and illustrated in their interesting catalogue.

VANDERPOOL BURGLAR ALARM.



The accompanying illustration shows a double window spring alarm manufactured by A. A. Vanderpool, of 372 South 19th street, Newark, N. J.

In placing this on the market every effort has been made to produce an article giving the best possible results. Wheels are provided which roll against the sash when lowered or raised. The contact points scrape, making a perfect connection. It is so simple that any necessary repairs may be made almost instantaneously. The device is reliable, is quickly and easily placed in position and costs very little.

NEW ENGLAND NOTES.

The Hawks Electric Company, of Boston, have secured the contract for the installation of a dynamo and incandescent street plant for the town of Raymond, N. H.

The Armington & Sims Engine Company, of Providence, continue to report better business, and within the past few weeks have closed contracts for a dozen or more of their well-known engines.

The Pettingell-Andrews Company, of Boston, have received the contract to furnish all the wire, fittings, etc., for the extension of the plant of the Colebrook Electric Light Company, of Colebrook, N. H.

The American Circular Loom Company, of Boston, have recently received an order for about twelve miles of their flexible conduit to be used in the new Hotel Majestic, New York City. This is a pretty good endorsement of its solid worth.

The W. S. Hill Electric Company, of Boston, are sending to their friends a very handsome calendar for 1894, this Christmas, got up with Mr. Poor's usual good taste. They have six different kinds to choose from, so that the most fastidious taste can be satisfied. Apply early.

The Reading Traction Company, of Reading, Pa., have placed the order for their new car house with the Berlin Iron Bridge Company, of East Berlin, Conn. The side walls will be of brick, the roof of iron. The building will be 85 feet in width and 180 feet in length. The width is divided into two parts of 42½ feet each, a row of columns supporting trusses at the centre.

The Exchange Club, Boston.—The contract for wiring this handsome new down-town club in Boston, has been given to the Hawks Electric Company, of Boston. This company will provide all the wiring and fixtures, and will use in the construction conduit made by the Interior Conduit Company of New York, about 40,000 feet of rubber-covered wire varying in sizes from No. 000 to No. 14 B. & S. Cumner, Craig & Co., of Boston, have the contract to furnish the switchboard and dynamos, of which there will be two, one 60 kilowatt, and one 15 kilowatt, both of the Crocker-Wheeler manufacture.

Mr. H. W. Colby, recently connected with the New York office of the Mather Electric Company, has patented an ingenious car fender, specially adapted for use on electric railroads. The Colby automatic fender is widely different from the multitude of fenders recently put on the market, and consists, roughly, of revolving brushes, which will not only prevent a man from possibly getting under the wheels of a car in motion, but are calculated to brush him to one side. The brushes do not revolve at all times, but can be put in motion instantly by the motor man. A car is now being equipped with this device, and we hope soon to be able to present it in more detailed form to our readers.

G. M. Angier & Company, of Boston, have succeeded Claflin & Kimball, Incor., as New England agents of the Mather Electric Company, with offices at No. 116 Bedford street, Boston. During the last two years, Mr. Angier has had charge of the selling department of The Mather Electric Company and its various branch offices, located throughout the United States. He has resigned this position, however, and will hereafter be the active manager of the new firm. The Mather dynamo has been on the market for the past six years, and is in operation in over 1,000 of the largest mills in the country. The Mather machine is particularly adapted for large buildings and manufacturing establishments. Mr. C. A. Bowditch, who has been connected with the Thomson-Houston and General Electric Companies, for the last six years, has resigned his position with the General Electric Company and will have charge of the motor department.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.